

**California High-Speed Rail Authority**



**RFP No.: HSR 13-57**

**Request for Proposal for Design-Build  
Services for Construction Package 2-3**

**Book IV, Part C.4 – Preliminary Ground  
Motions Guidelines**





## TABLE OF CONTENTS

Ground Motion Description

Construction Package 2-3 Ground Motion Zone Map

Design Spectra Zones 3, 4a and 4b – MCE & OBE

Design Spectra for Special Sites (Reference Rock Outcrop Vs30 of 520, 760 and 1220 m/s) – MCE & OBE

Time History Zones 3, 4a and 4b – MCE<sup>(1)</sup>

Time History Zones Zones 3, 4a and 4b – OBE<sup>(1)</sup>

Time History for Special Sites (Reference Rock Outcrop Vs30 of 520, 760 and 1220 m/s) – MCE<sup>(1)</sup>

Time History for Special Sites (Reference Rock Outcrop Vs30 of 520, 760 and 1220 m/s) – OBE<sup>(1)</sup>

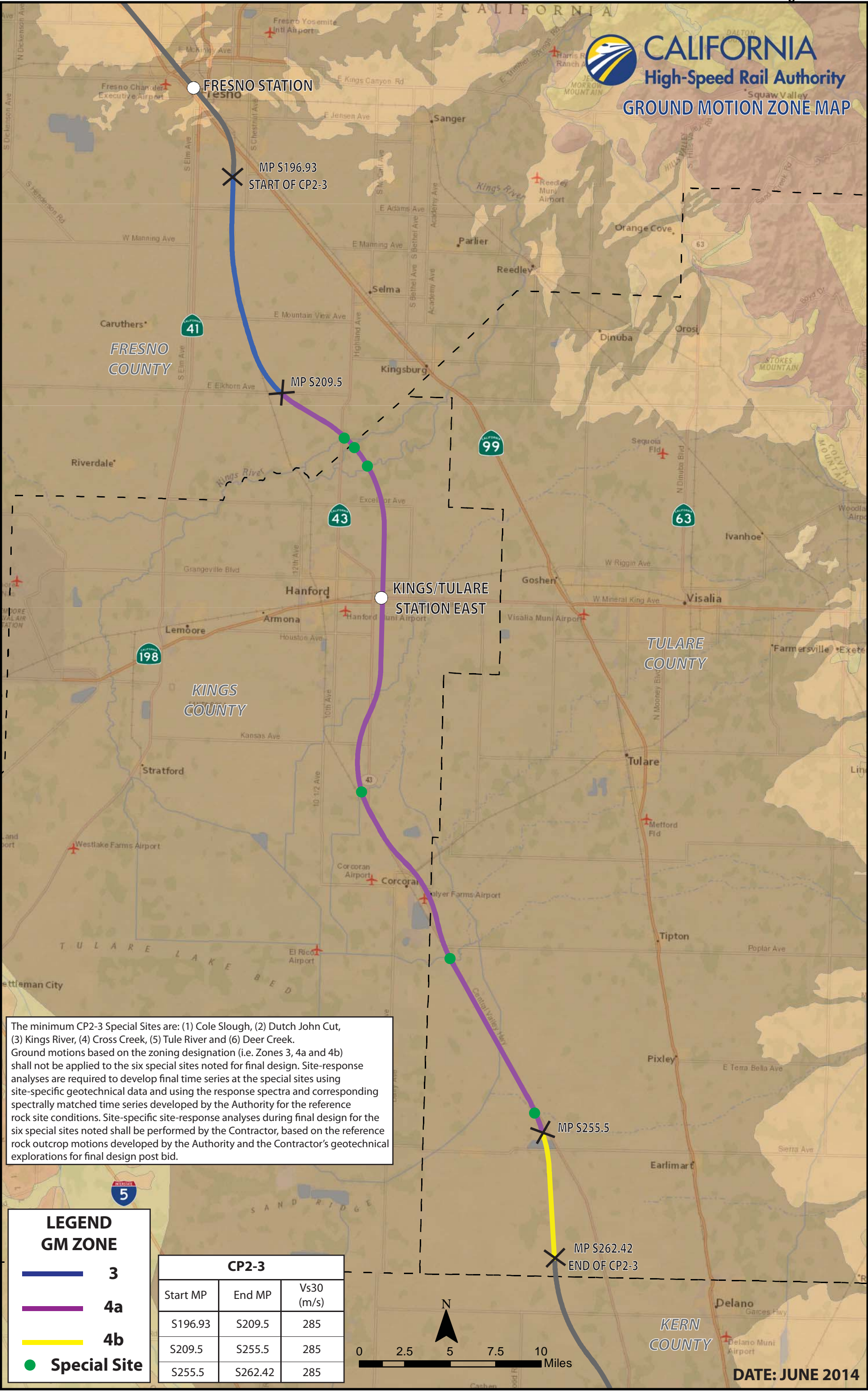
<sup>(1)</sup> Data points not plotted, see Attachments for data point files

## GROUND MOTIONS FOR DESIGN OF CONSTRUCTION PACKAGE 2-3 CALIFORNIA HIGH SPEED RAIL PROJECT

Ground motions are provided for three zones and special sites on the Construction Package 2-3 alignment of the California High Speed Train Project. The Ground Motion Zone Map defines the limits of these zones. This section includes digital formats of the ground motions, developed for design at Operating Basis Earthquake (OBE) and Maximum Considered Earthquake (MCE) seismic hazard levels, and the documented plots for these motions.

Included are the design spectra and seven digitally formatted files of developed ground motions for the OBE and MCE seismic design events, respectively. Each file includes seven sets of spectrally-matched motions (SMMs). Each SMM set, denoted by a Next Generation Attenuation (NGA) Models number (e.g., NGA\_no\_1094) leading the filename, includes three files representing for three components in Horizontal 1 (H1-), Horizontal 2 (H2-), and Vertical (V-) directions, respectively. Each of these three files includes the number of data points, time interval, two dummy numbers, and the digital formats for acceleration (denoted by accel in units of g), velocity (denoted by vel in units of cm/s), and displacement (denoted by displ in units of cm) history.

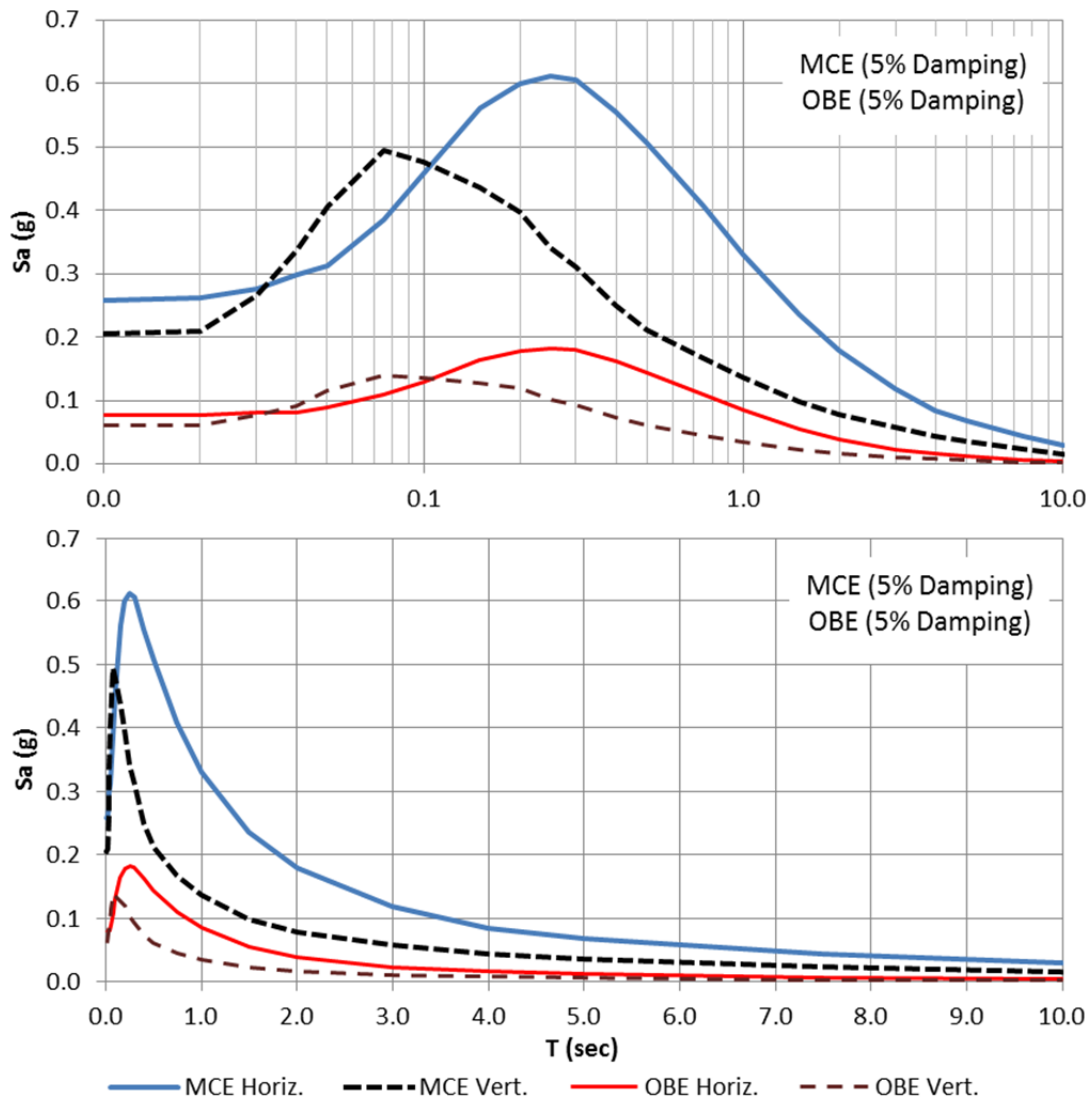
The PDF files for documented plots, ground motion metrics for selected seed motions and SMMs are first listed in a table. These metrics are earthquake name, year of the earthquake event, station name, moment magnitude (Mw), and distance (R) for each selected seed motion, and peak ground acceleration (PGA), peak ground velocity (PGV), peak ground displacement (PGD) in H1-, H2-, and V-directions, respectively, for each SMM. This is followed by 21 plates, each of which presents plots of time histories and SMM spectrum plotted against design spectrum for one component of the developed ground motions. The NGA number appeared in the filename of digital formats also services as a reference (appeared as NGA#) to the documented plots of the developed ground motions. In each plate, plots in the left show the time histories of acceleration (A), velocity (V), and displacement (D) of SMM. A signed peak value is shown at the right of each time history plot. Positive peak value for A, V, or D is located above the baseline of the time history, while negative peak value is shown below the baseline. In the right plot of each plate, the computed SMM spectrum is plotted against the target spectrum.







## Zone 3



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.2590	0.2051	0.0762	0.0604	0.40	0.5550	0.2507	0.1620	0.0732
0.02	0.2620	0.2088	0.0767	0.0611	0.50	0.5060	0.2113	0.1440	0.0601
0.03	0.2760	0.2663	0.0802	0.0774	0.75	0.4080	0.1665	0.1100	0.0449
0.04	0.2980	0.3367	0.0814	0.0920	1.00	0.3310	0.1366	0.0854	0.0352
0.05	0.3130	0.4052	0.0894	0.1157	1.50	0.2360	0.0988	0.0557	0.0233
0.08	0.3860	0.4945	0.1090	0.1396	2.00	0.1800	0.0780	0.0392	0.0170
0.10	0.4580	0.4757	0.1300	0.1350	3.00	0.1180	0.0578	0.0228	0.0112
0.15	0.5610	0.4356	0.1630	0.1266	4.00	0.0846	0.0441	0.0156	0.0081
0.20	0.6000	0.3983	0.1790	0.1188	5.00	0.0680	0.0359	0.0117	0.0062
0.25	0.6120	0.3417	0.1820	0.1016	7.50	0.0434	0.0229	0.0059	0.0031
0.30	0.6060	0.3107	0.1810	0.0928	10.00	0.0294	0.0155	0.0034	0.0018



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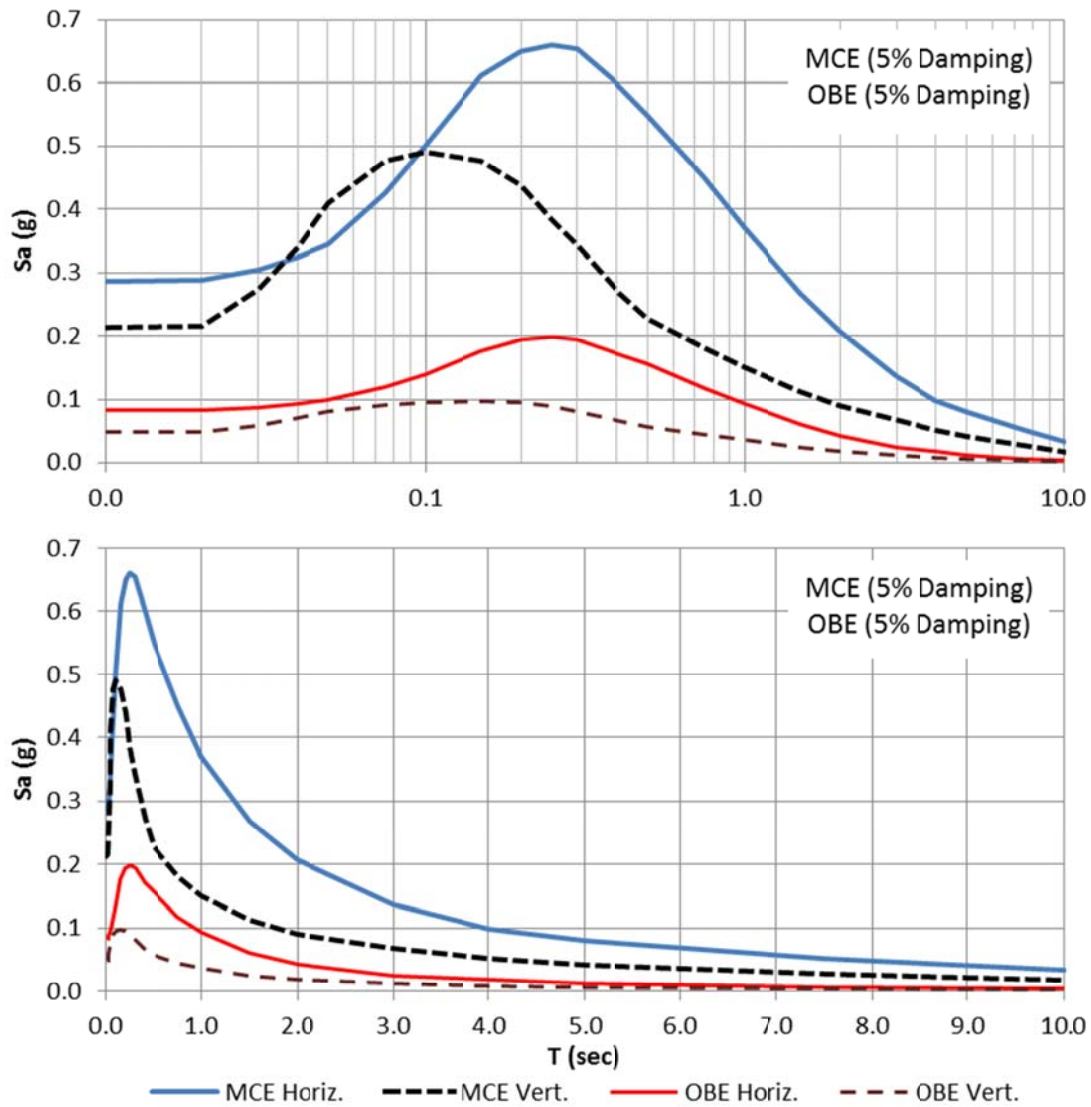
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Hoss Hayati  
Jinquan Zhong  
Jeff Bayless  
Paul Somerville  
05/20/2014

**PLATE 3. ZONE 3 DESIGN SPECTRA:  
MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT

## Zone 4a



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.2870	0.2136	0.0823	0.0482	0.40	0.6000	0.2729	0.1720	0.0665
0.02	0.2890	0.2165	0.0828	0.0485	0.50	0.5490	0.2286	0.1560	0.0576
0.03	0.3040	0.2741	0.0861	0.0594	0.75	0.4510	0.1818	0.1180	0.0441
0.04	0.3250	0.3412	0.0922	0.0702	1.00	0.3710	0.1507	0.0924	0.0355
0.05	0.3460	0.4092	0.0983	0.0812	1.50	0.2690	0.1119	0.0610	0.0249
0.08	0.4250	0.4767	0.1190	0.0909	2.00	0.2080	0.0903	0.0428	0.0186
0.10	0.5000	0.4900	0.1400	0.0946	3.00	0.1370	0.0672	0.0253	0.0125
0.15	0.6120	0.4757	0.1760	0.0982	4.00	0.0992	0.0517	0.0173	0.0091
0.20	0.6510	0.4378	0.1950	0.0960	5.00	0.0802	0.0424	0.0131	0.0070
0.25	0.6610	0.3833	0.1980	0.0894	7.50	0.0512	0.0271	0.0067	0.0036
0.30	0.6550	0.3423	0.1950	0.0815	10.00	0.0343	0.0181	0.0038	0.0020



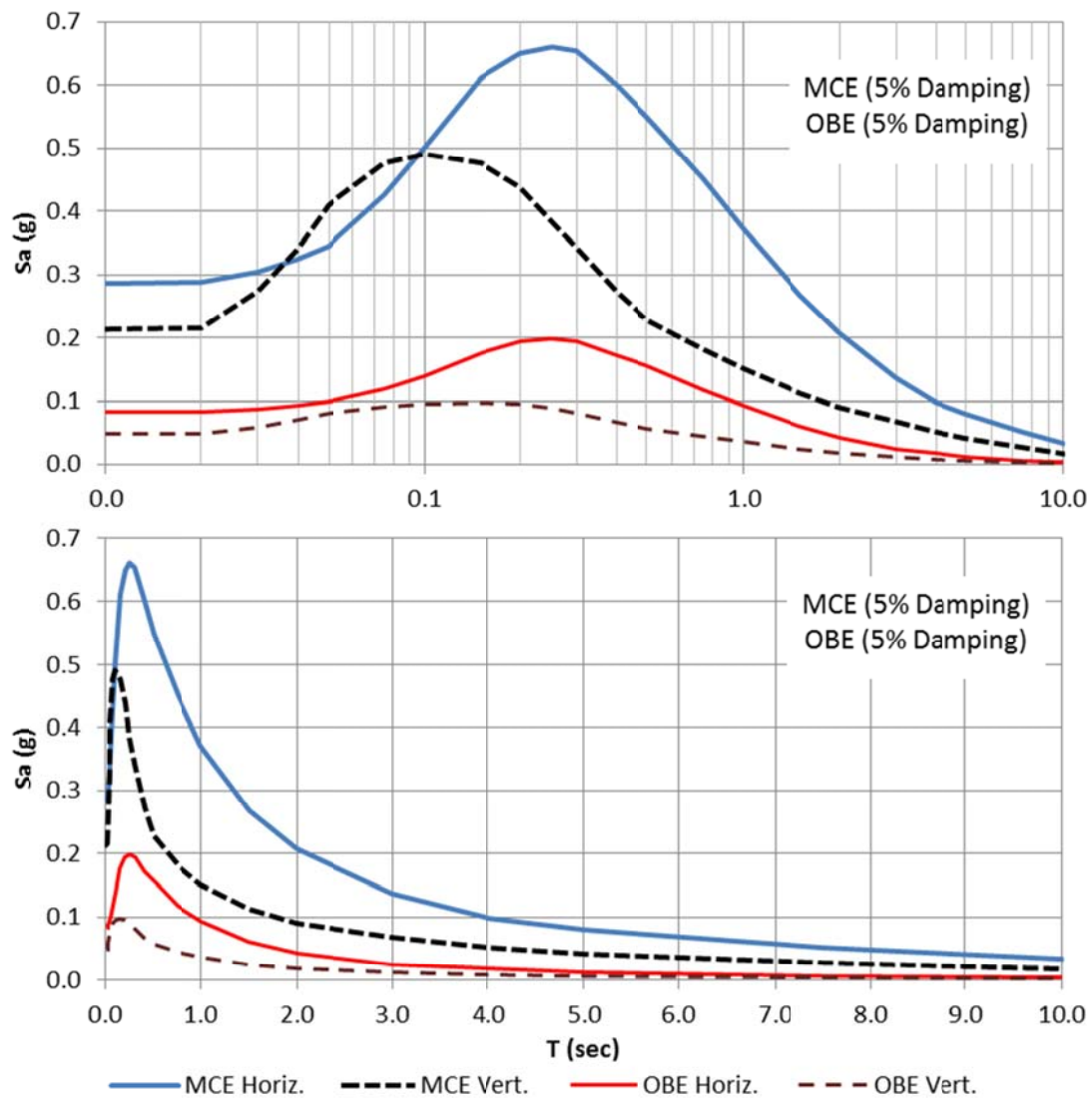
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**PLATE 1. ZONE 4a DESIGN  
SPECTRA: MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT

## Zone 4b



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.2870	0.2136	0.0823	0.0482	0.40	0.6000	0.2729	0.1720	0.0665
0.02	0.2890	0.2165	0.0828	0.0485	0.50	0.5490	0.2286	0.1560	0.0576
0.03	0.3040	0.2741	0.0861	0.0594	0.75	0.4510	0.1818	0.1180	0.0441
0.04	0.3250	0.3412	0.0922	0.0702	1.00	0.3710	0.1507	0.0924	0.0355
0.05	0.3460	0.4092	0.0983	0.0812	1.50	0.2690	0.1119	0.0610	0.0249
0.08	0.4250	0.4767	0.1190	0.0909	2.00	0.2080	0.0903	0.0428	0.0186
0.10	0.5000	0.4900	0.1400	0.0946	3.00	0.1370	0.0672	0.0253	0.0125
0.15	0.6120	0.4757	0.1760	0.0982	4.00	0.0992	0.0517	0.0173	0.0091
0.20	0.6510	0.4378	0.1950	0.0960	5.00	0.0802	0.0424	0.0131	0.0070
0.25	0.6610	0.3833	0.1980	0.0894	7.50	0.0512	0.0271	0.0067	0.0036
0.30	0.6550	0.3423	0.1950	0.0815	10.00	0.0343	0.0181	0.0038	0.0020



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Jeff Bayless

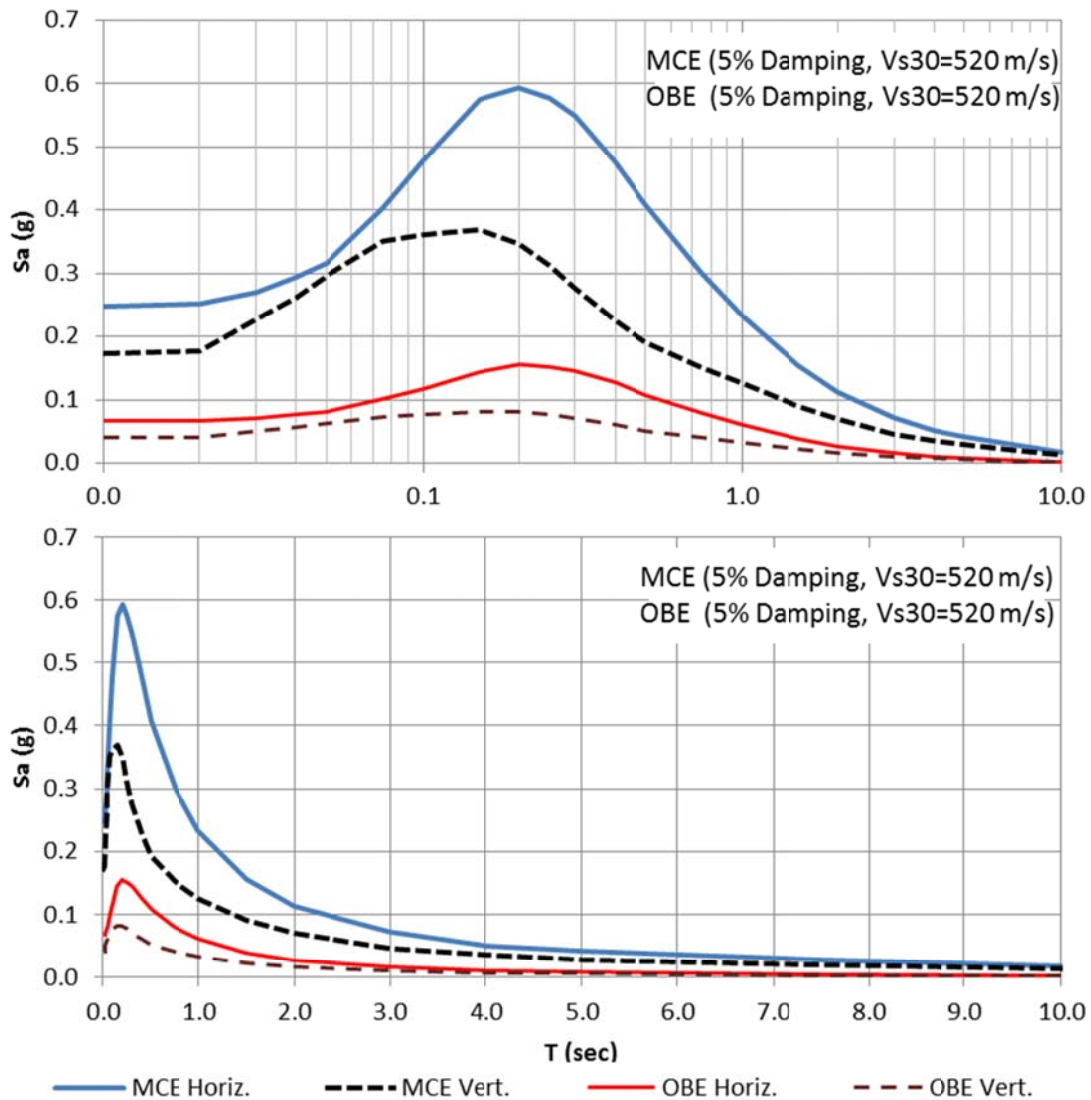
Paul Somerville

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**PLATE 2. ZONE 4b DESIGN SPECTRA:  
MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT

## CP2-3 SPECIAL SITES: Vs30=520 m/s



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.2480	0.1730	0.0664	0.0409	0.40	0.4760	0.2265	0.1270	0.0603
0.02	0.2520	0.1762	0.0671	0.0413	0.50	0.4090	0.1917	0.1080	0.0509
0.03	0.2700	0.2271	0.0703	0.0510	0.75	0.3000	0.1514	0.0795	0.0404
0.04	0.2935	0.2617	0.0760	0.0567	1.00	0.2330	0.1261	0.0608	0.0331
0.05	0.3170	0.2963	0.0816	0.0623	1.50	0.1550	0.0906	0.0392	0.0232
0.08	0.4030	0.3520	0.1010	0.0723	2.00	0.1130	0.0696	0.0268	0.0167
0.10	0.4780	0.3620	0.1180	0.0770	3.00	0.0721	0.0466	0.0156	0.0102
0.15	0.5750	0.3691	0.1440	0.0815	4.00	0.0509	0.0350	0.0105	0.0073
0.20	0.5930	0.3480	0.1550	0.0812	5.00	0.0412	0.0287	0.0078	0.0055
0.25	0.5770	0.3134	0.1510	0.0767	7.50	0.0268	0.0187	0.0040	0.0028
0.30	0.5490	0.2764	0.1450	0.0701	10.00	0.0181	0.0126	0.0023	0.0016



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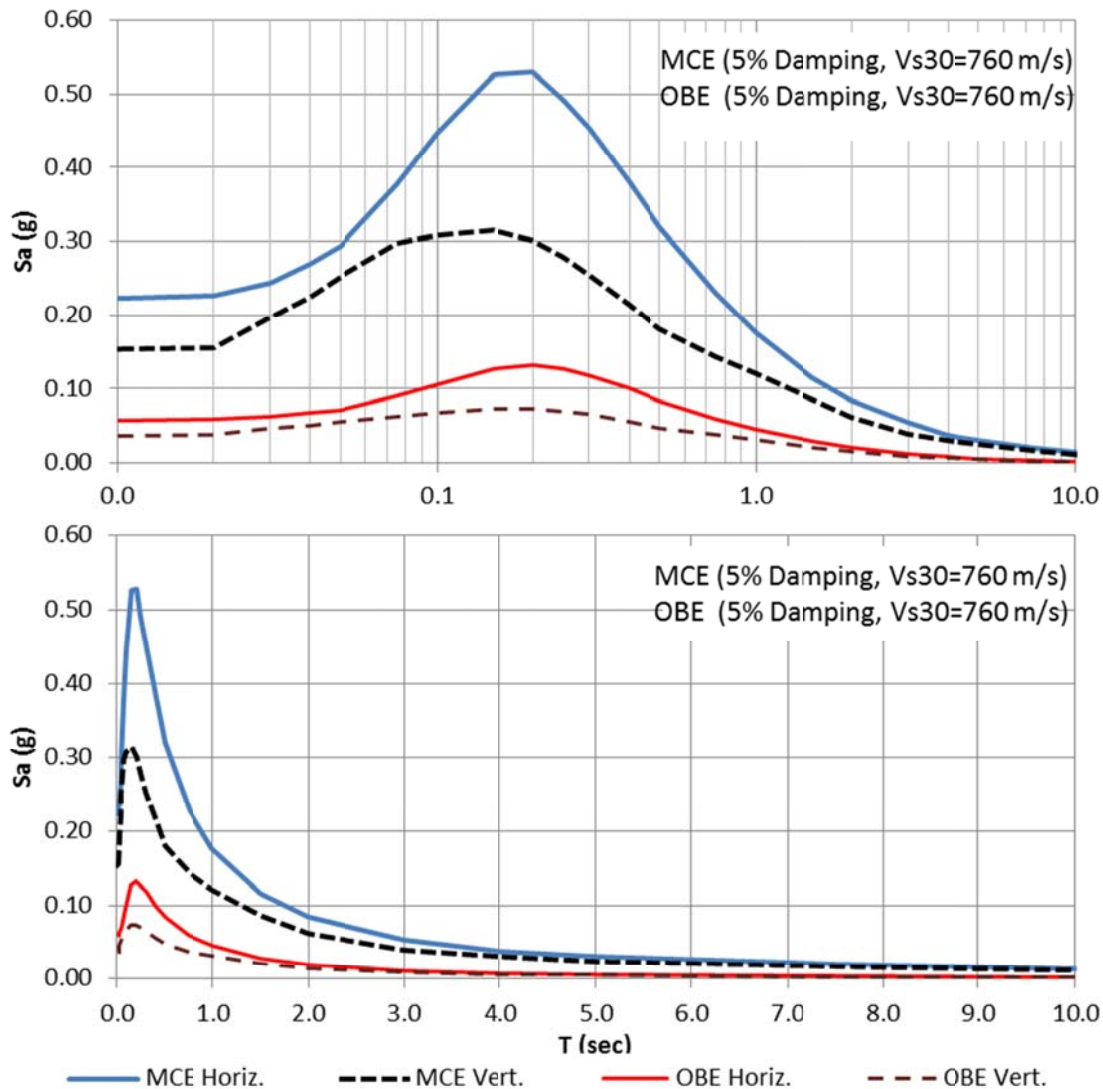
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**PLATE 1. CP2-3 SPECIAL SITES  
(Vs30=520 m/s) DESIGN SPECTRA:  
MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT



## CP2-3 SPECIAL SITES: Vs30=760 m/s



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.2230	0.1532	0.0575	0.0369	0.40	0.3810	0.2151	0.1000	0.0563
0.02	0.2270	0.1561	0.0586	0.0376	0.50	0.3200	0.1808	0.0839	0.0477
0.03	0.2440	0.1974	0.0623	0.0460	0.75	0.2290	0.1434	0.0595	0.0375
0.04	0.2690	0.2250	0.0671	0.0504	1.00	0.1760	0.1206	0.0454	0.0313
0.05	0.2940	0.2526	0.0719	0.0548	1.50	0.1160	0.0864	0.0288	0.0217
0.08	0.3770	0.2976	0.0896	0.0631	2.00	0.0845	0.0622	0.0201	0.0150
0.10	0.4460	0.3076	0.1050	0.0682	3.00	0.0539	0.0399	0.0116	0.0087
0.15	0.5260	0.3152	0.1270	0.0731	4.00	0.0382	0.0301	0.0079	0.0063
0.20	0.5290	0.3012	0.1320	0.0734	5.00	0.0309	0.0247	0.0060	0.0048
0.25	0.4910	0.2779	0.1260	0.0701	7.50	0.0206	0.0165	0.0032	0.0026
0.30	0.4540	0.2535	0.1180	0.0652	10.00	0.0140	0.0112	0.0019	0.0016



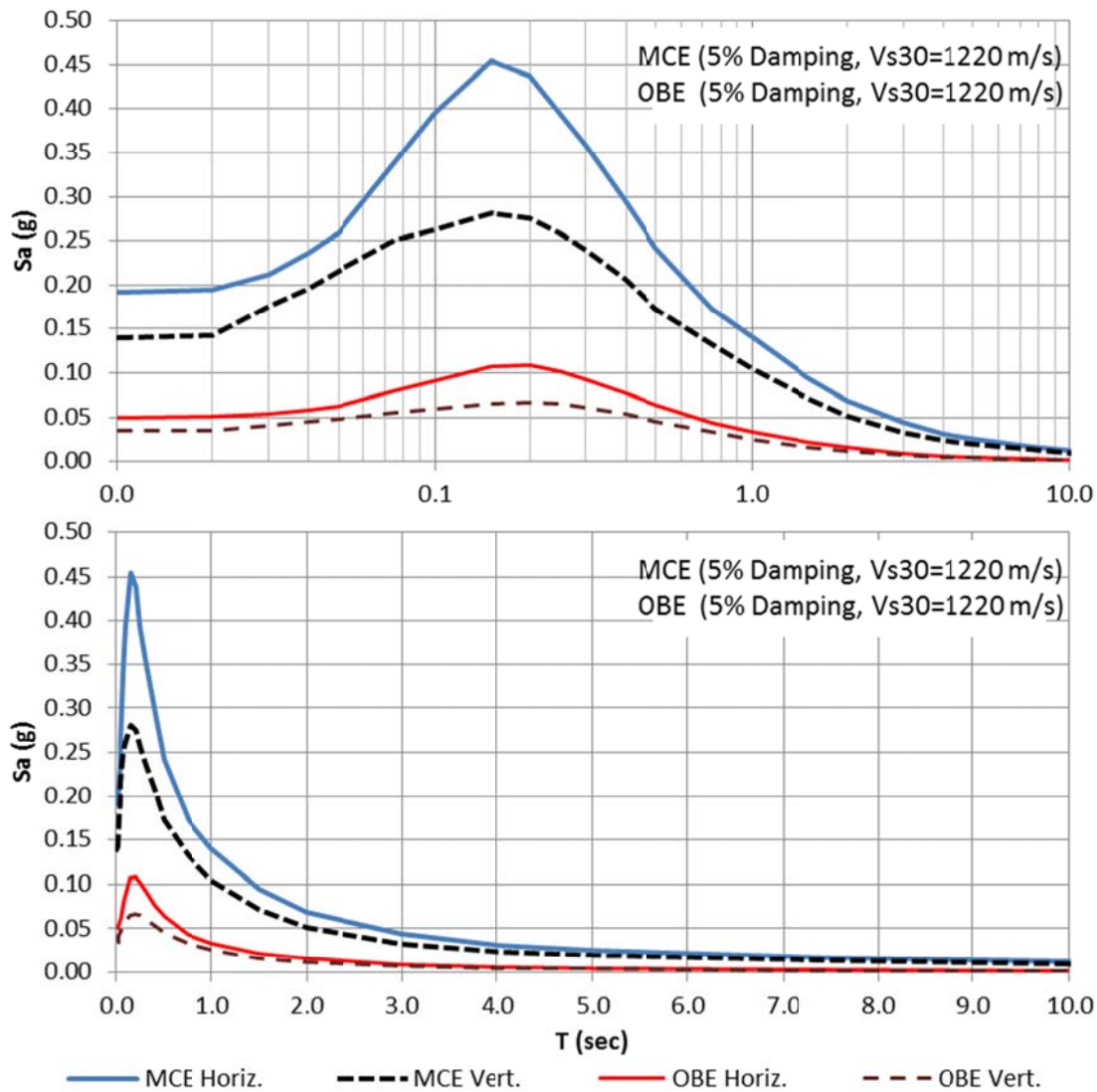
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**PLATE 2. CP2-3 SPECIAL SITES  
(Vs30=760 m/s) DESIGN SPECTRA:  
MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT

## CP2-3 SPECIAL SITES: Vs30=1220 m/s



Period, T (sec)	Spectral Acceleration, Sa (g)				Period, T (sec)	Spectral Acceleration, Sa (g)			
	MCE (5% Damping)		OBE (5% Damping)			MCE (5% Damping)		OBE (5% Damping)	
	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical	Horizontal	Vertical
0.01	0.1910	0.1390	0.0495	0.0342	0.40	0.2940	0.2054	0.0763	0.0532
0.02	0.1950	0.1420	0.0505	0.0349	0.50	0.2420	0.1726	0.0633	0.0454
0.03	0.2120	0.1752	0.0532	0.0413	0.75	0.1730	0.1325	0.0438	0.0338
0.04	0.2360	0.1955	0.0581	0.0448	1.00	0.1410	0.1045	0.0340	0.0254
0.05	0.2600	0.2158	0.0629	0.0482	1.50	0.0953	0.0713	0.0219	0.0166
0.08	0.3390	0.2507	0.0790	0.0551	2.00	0.0692	0.0510	0.0154	0.0115
0.10	0.3960	0.2623	0.0908	0.0598	3.00	0.0438	0.0325	0.0089	0.0067
0.15	0.4540	0.2809	0.1070	0.0657	4.00	0.0308	0.0243	0.0062	0.0049
0.20	0.4380	0.2757	0.1090	0.0672	5.00	0.0248	0.0198	0.0047	0.0038
0.25	0.3940	0.2587	0.1010	0.0651	7.50	0.0166	0.0133	0.0026	0.0021
0.30	0.3580	0.2388	0.0926	0.0612	10.00	0.0120	0.0096	0.0016	0.0013



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**PLATE 3. CP2-3 SPECIAL SITES  
(Vs30=1220 m/s) DESIGN SPECTRA:  
MCE AND OBE**

CALIFORNIA HIGH SPEED TRAIN PROJECT

**Table A.5:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for Zone 3**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA	PGV	PGD	PGA	PGV	PGD	PGA	PGV	PGD
							H1 (g)	H1 (cm/s)	H1 (cm)	H2 (g)	H2 (cm/s)	H2 (cm)	V (g)	V (cm/s)	V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.249	28.127	18.947	0.242	30.939	20.922	0.204	18.384	15.208
2	840	Landers	1992	Big Tujunga, Angeles Nat F	7.28	144.13	0.256	26.081	9.395	0.257	25.615	8.824	0.205	14.401	3.772
3	176	Imperial Valley-06	1979	El Centro Array #13	6.53	21.98	0.253	28.439	18.263	0.252	34.144	12.242	0.197	14.639	6.491
4	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.246	31.094	15.614	0.264	33.614	16.987	0.205	16.244	7.084
5	1776	Hector Mine	1999	Desert Hot Springs	7.13	56.4	0.259	27.804	14.921	0.250	28.724	16.331	0.206	14.002	9.189
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.247	22.167	9.716	0.243	25.602	14.112	0.201	13.454	5.799
7	3497	Chi-Chi, Taiwan-06	1999	TCU112	6.30	51.72	0.260	30.300	14.547	0.257	23.826	11.554	0.204	10.496	6.108

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Nicholas Gregor

Jeff Bayless

Ken Campbell

05/22/2014

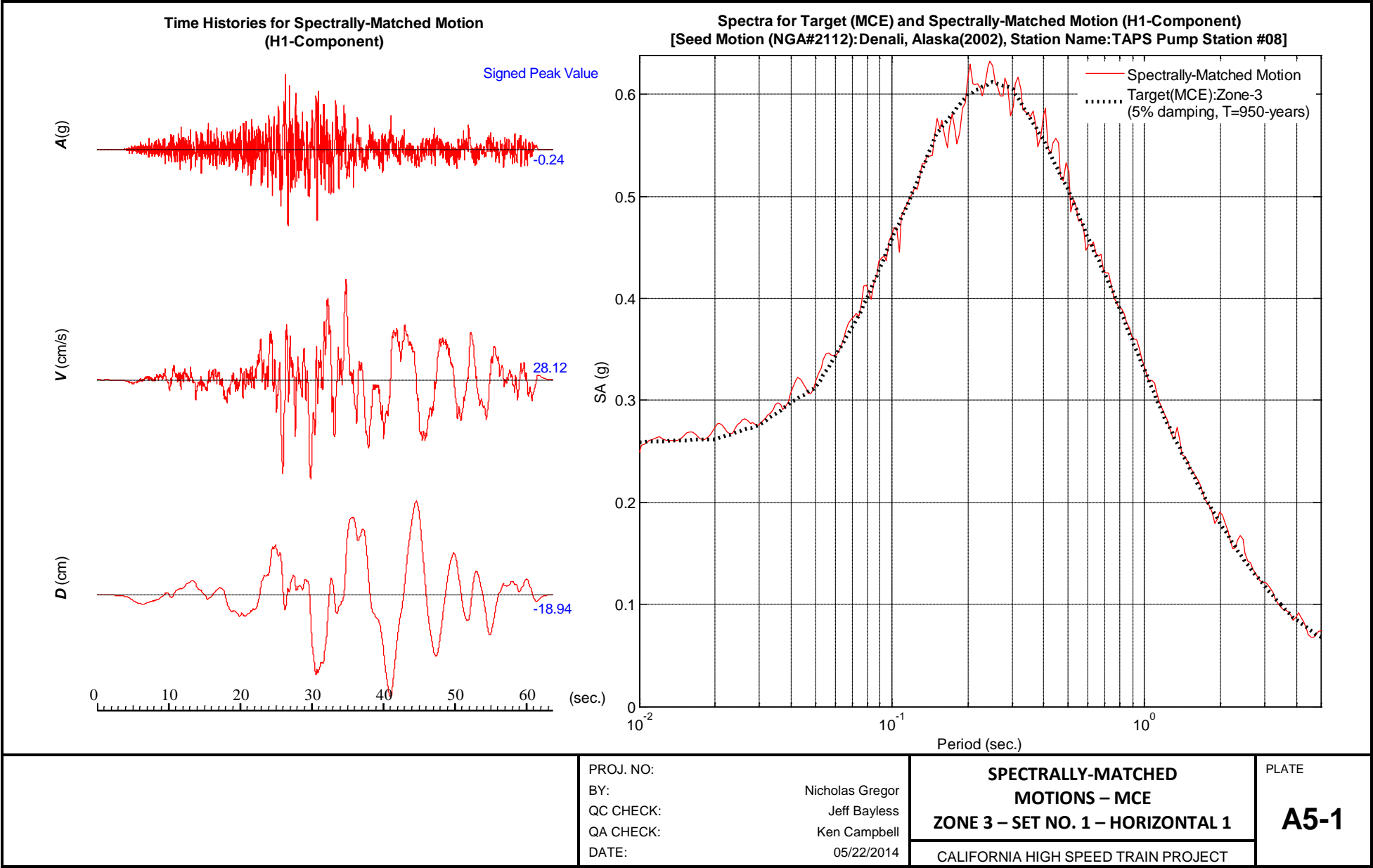
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
MCE – ZONE 3**

CALIFORNIA HIGH SPEED TRAIN PROJECT

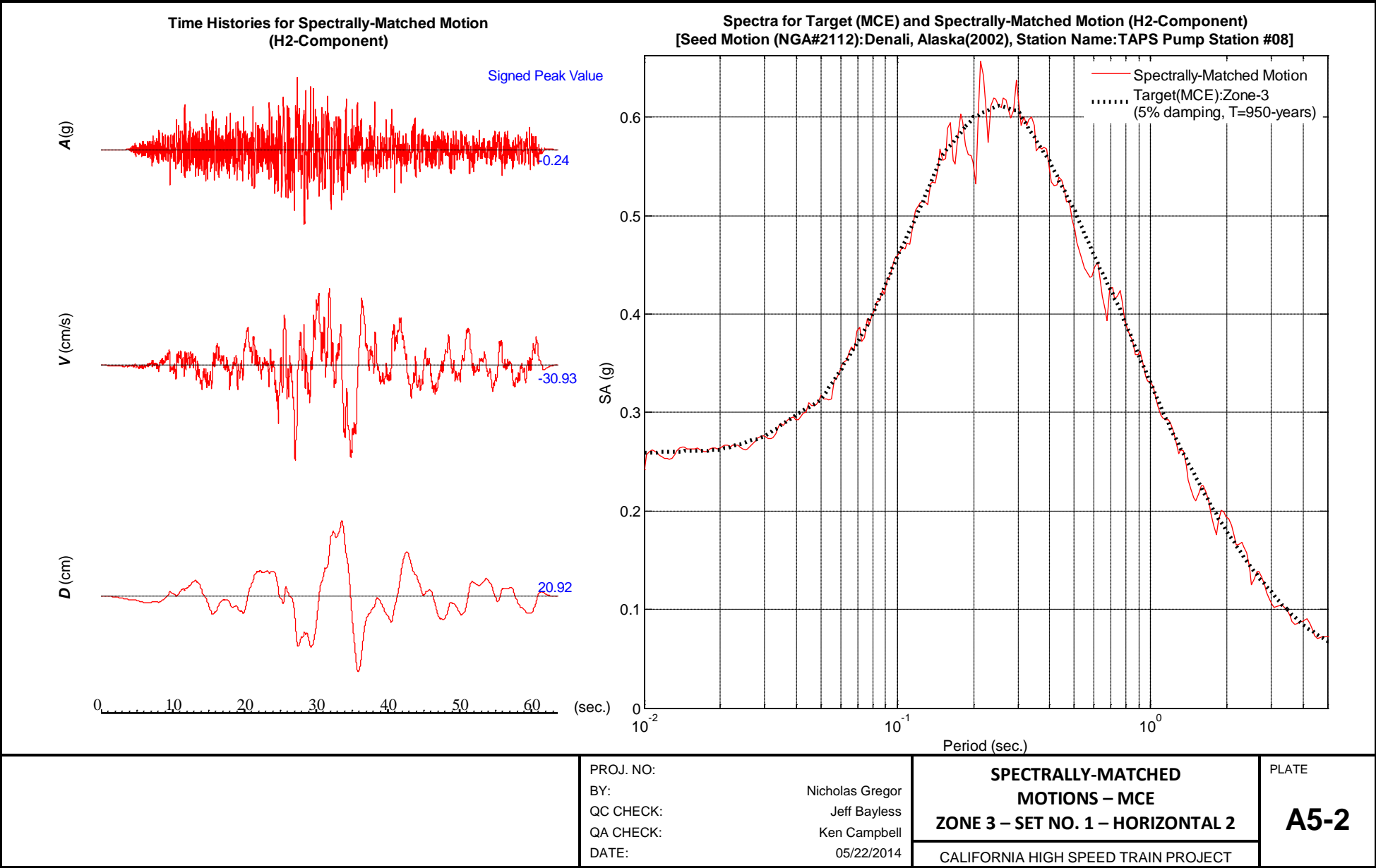
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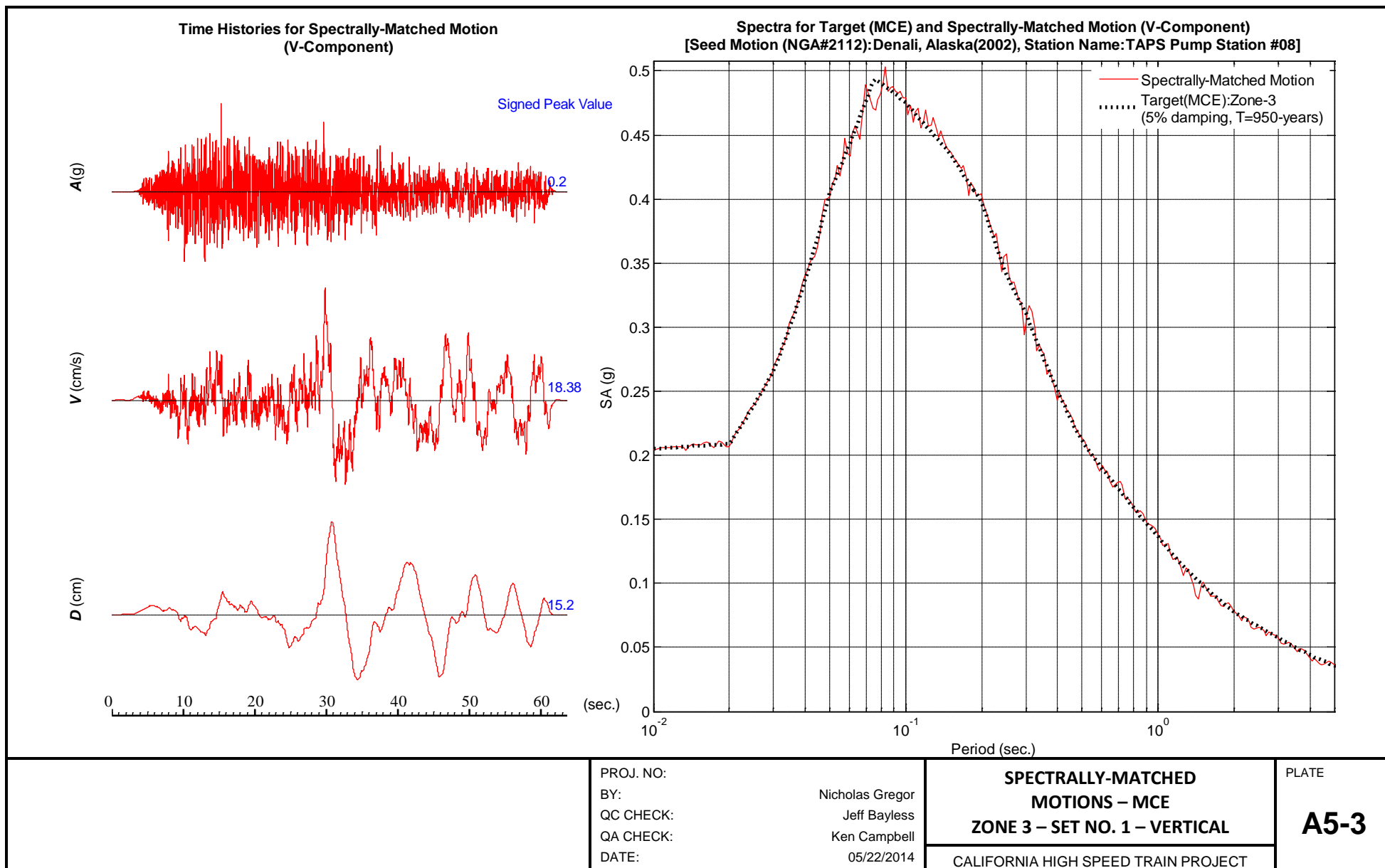
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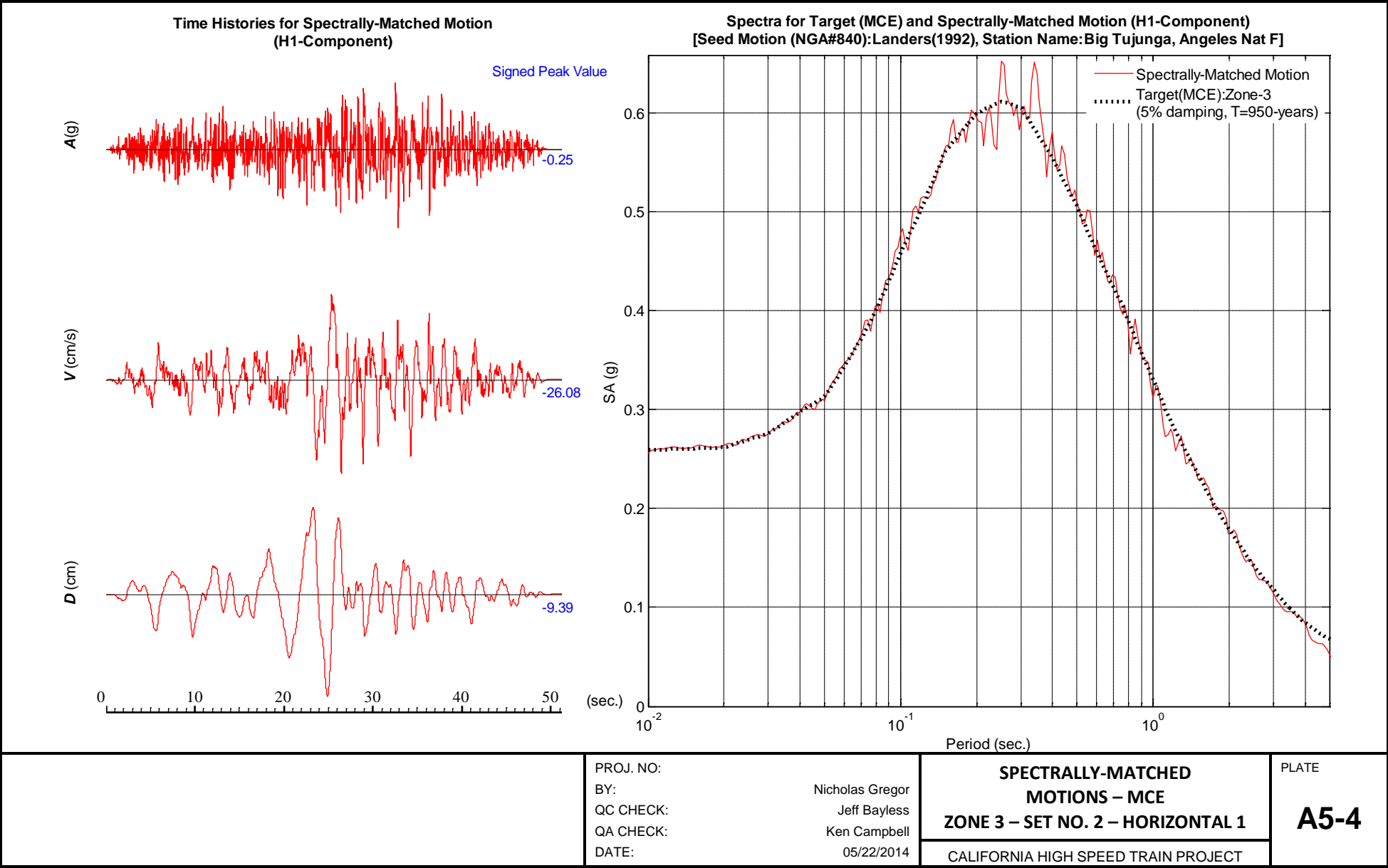


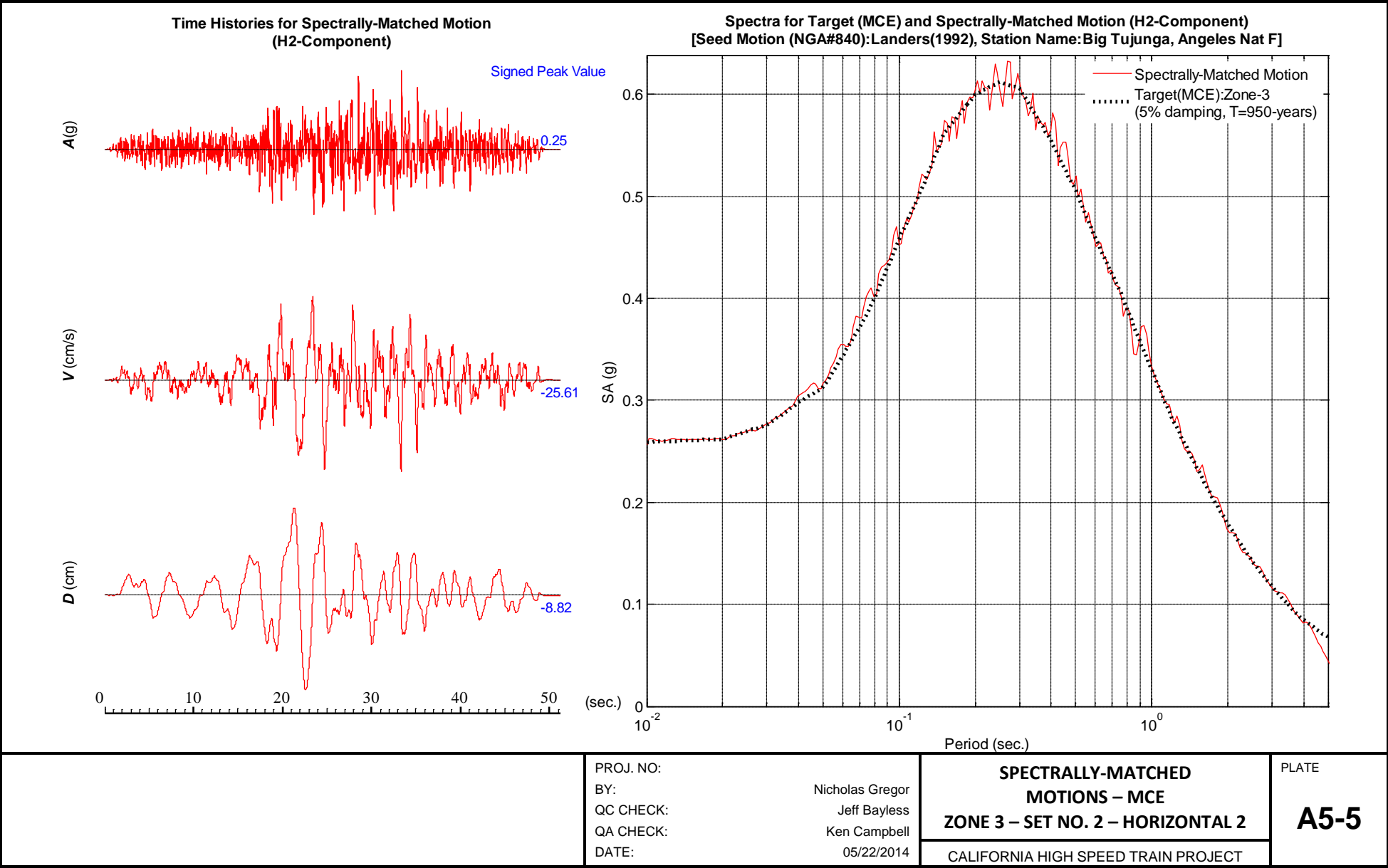
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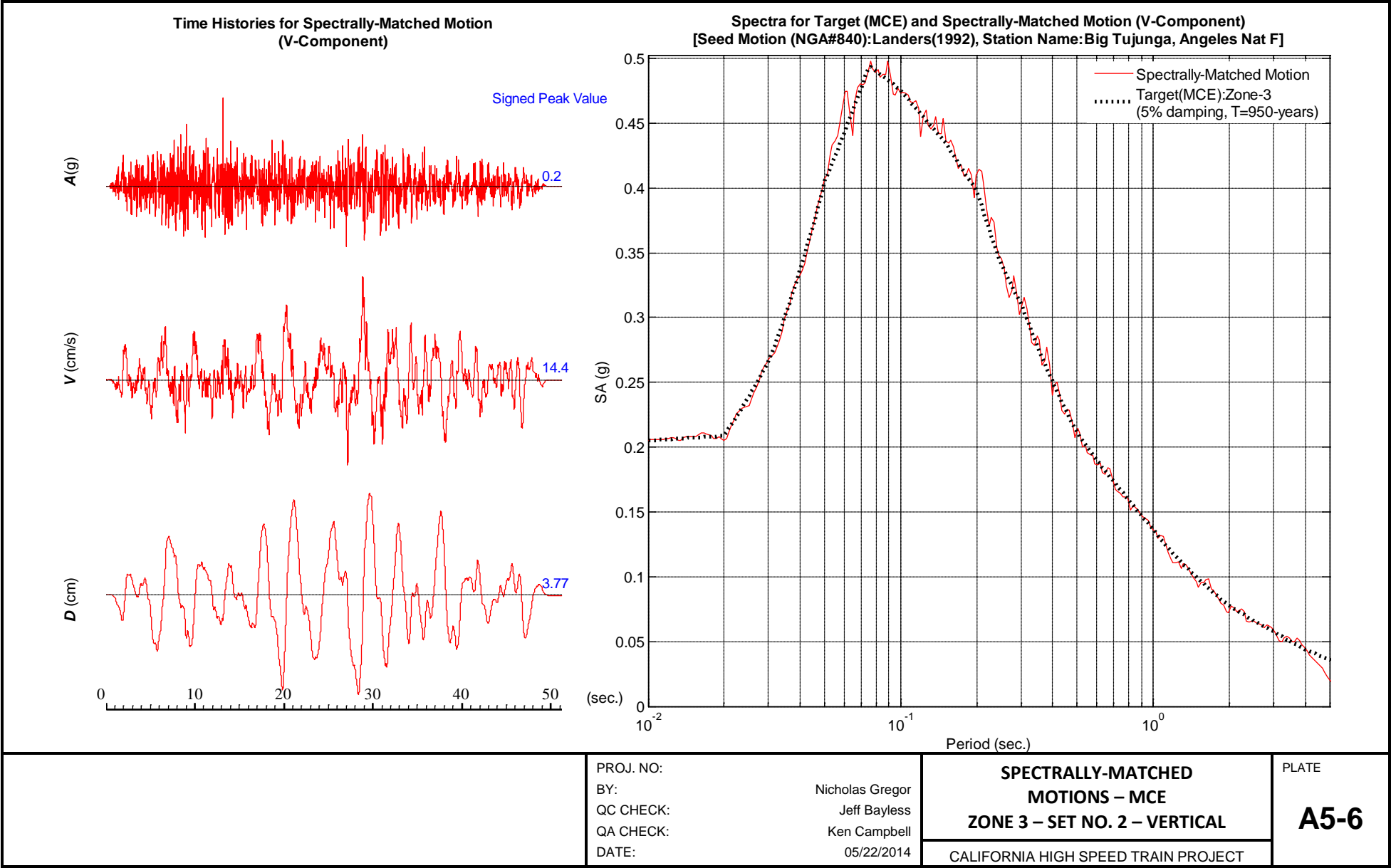
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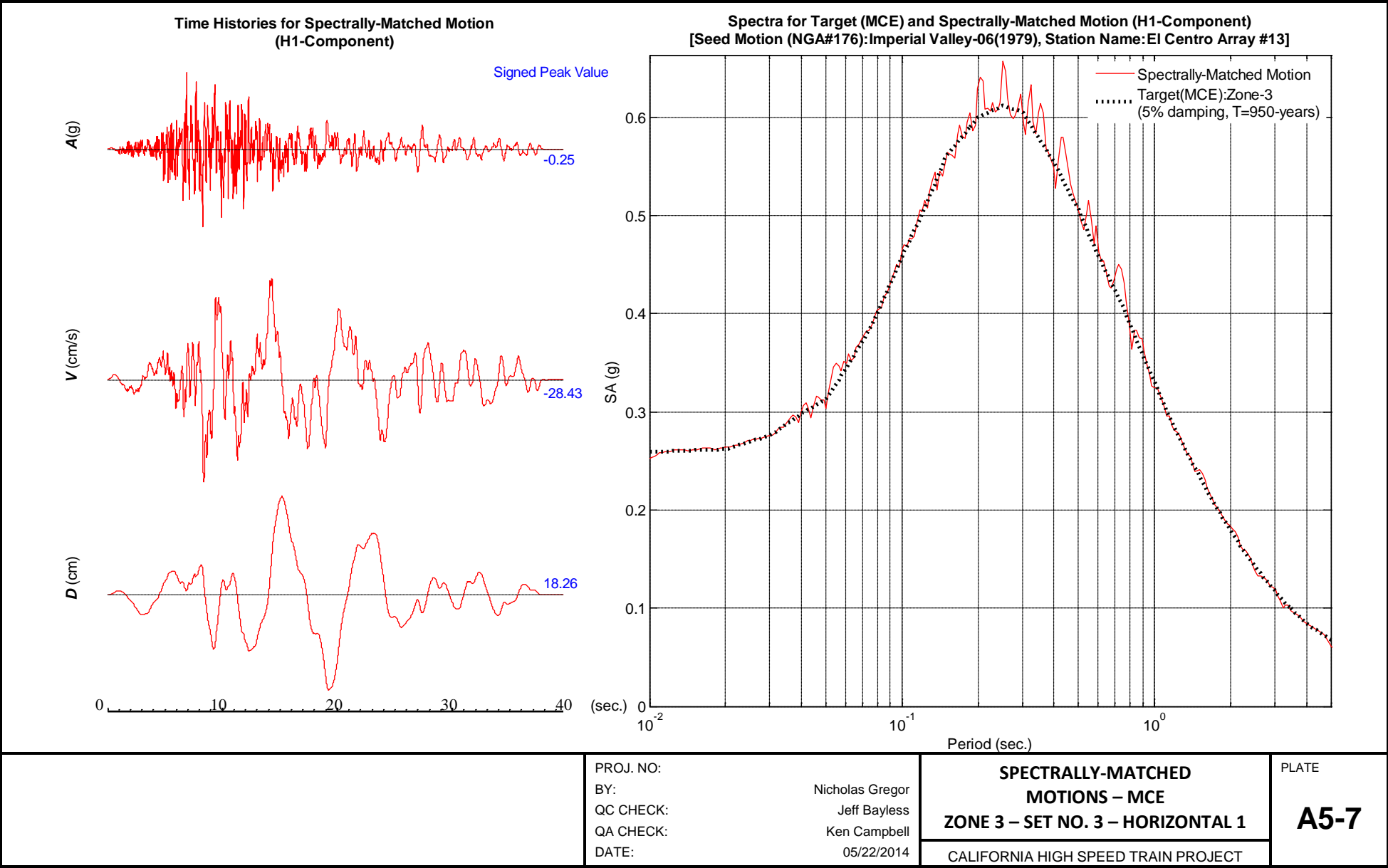


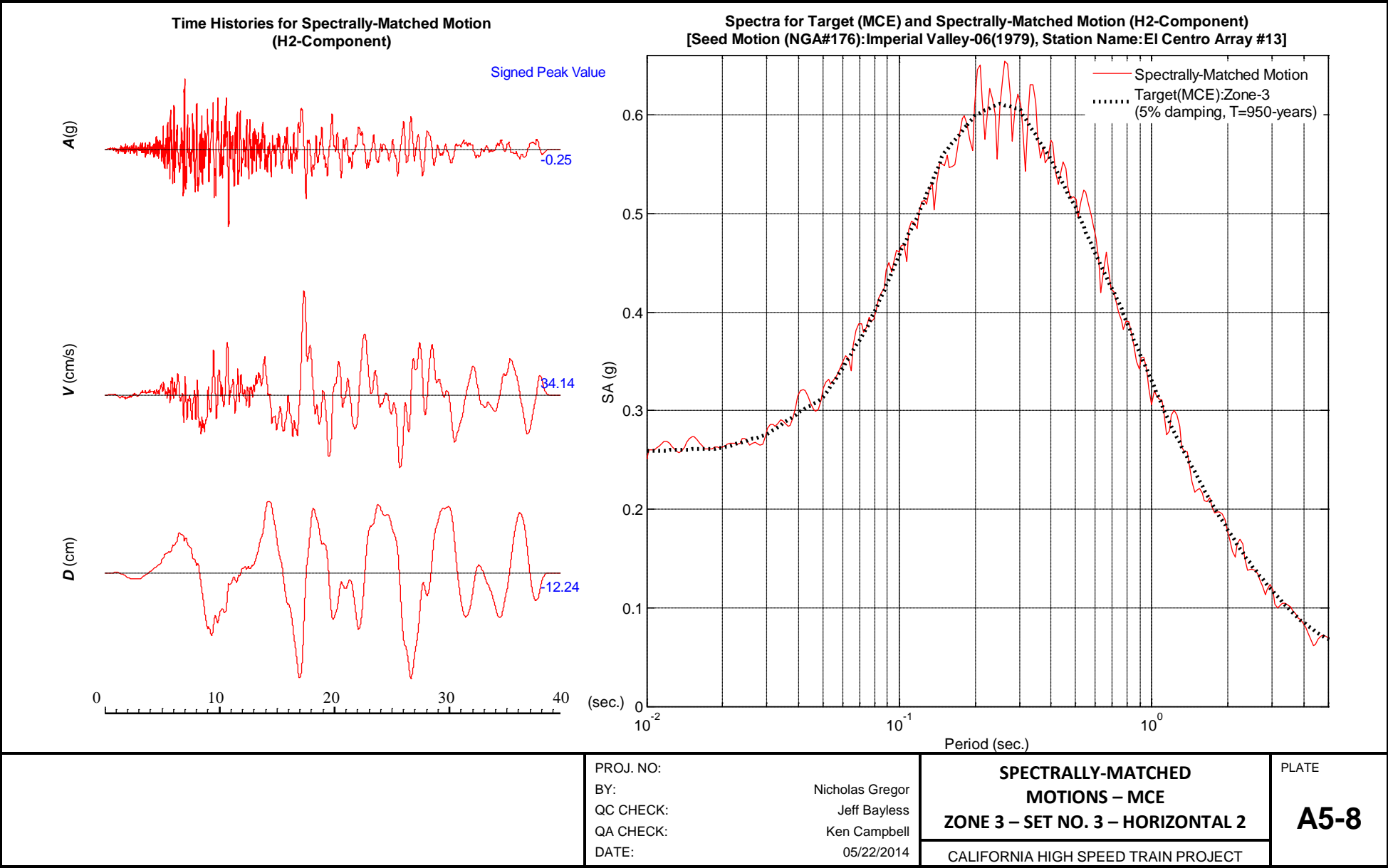


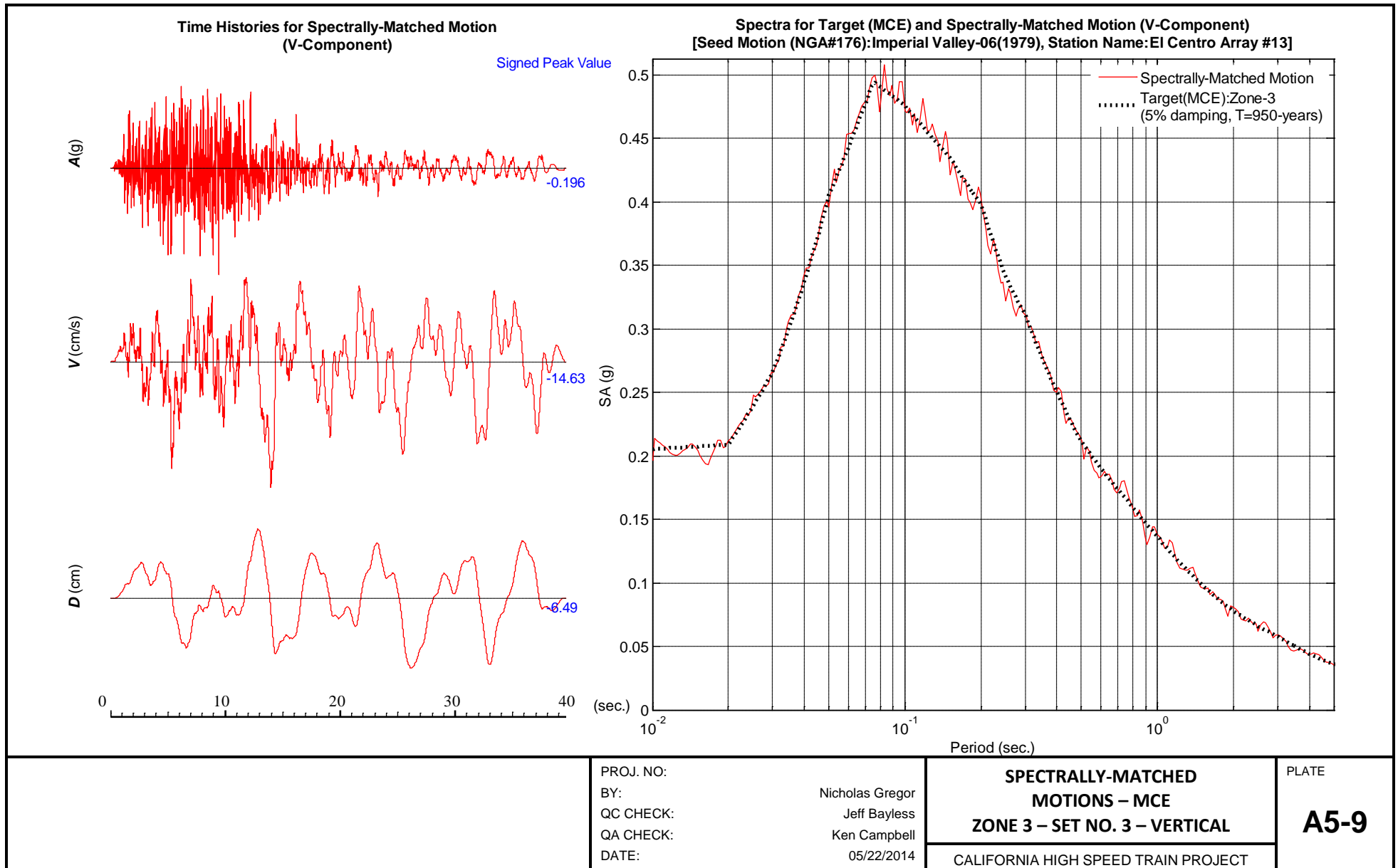


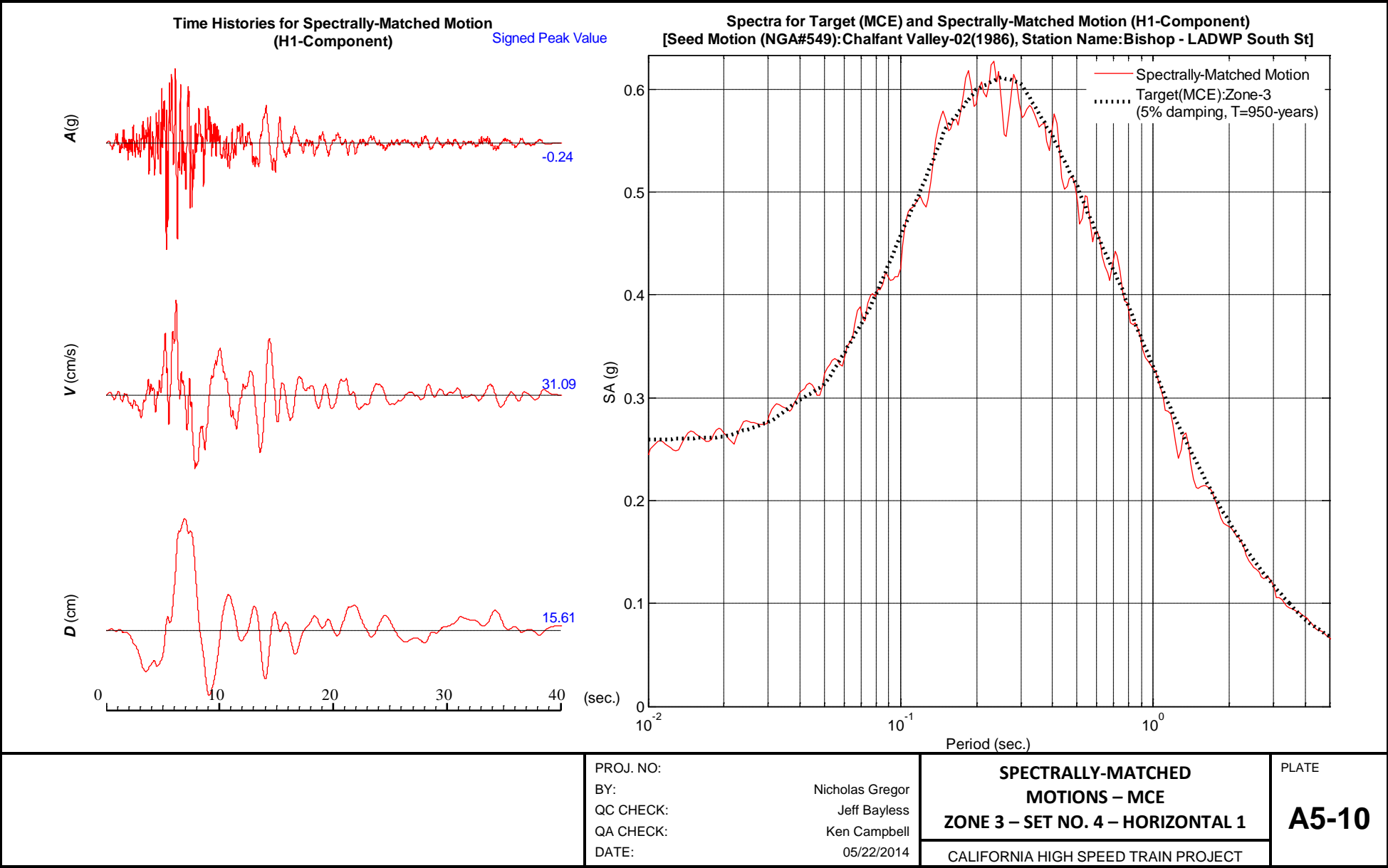


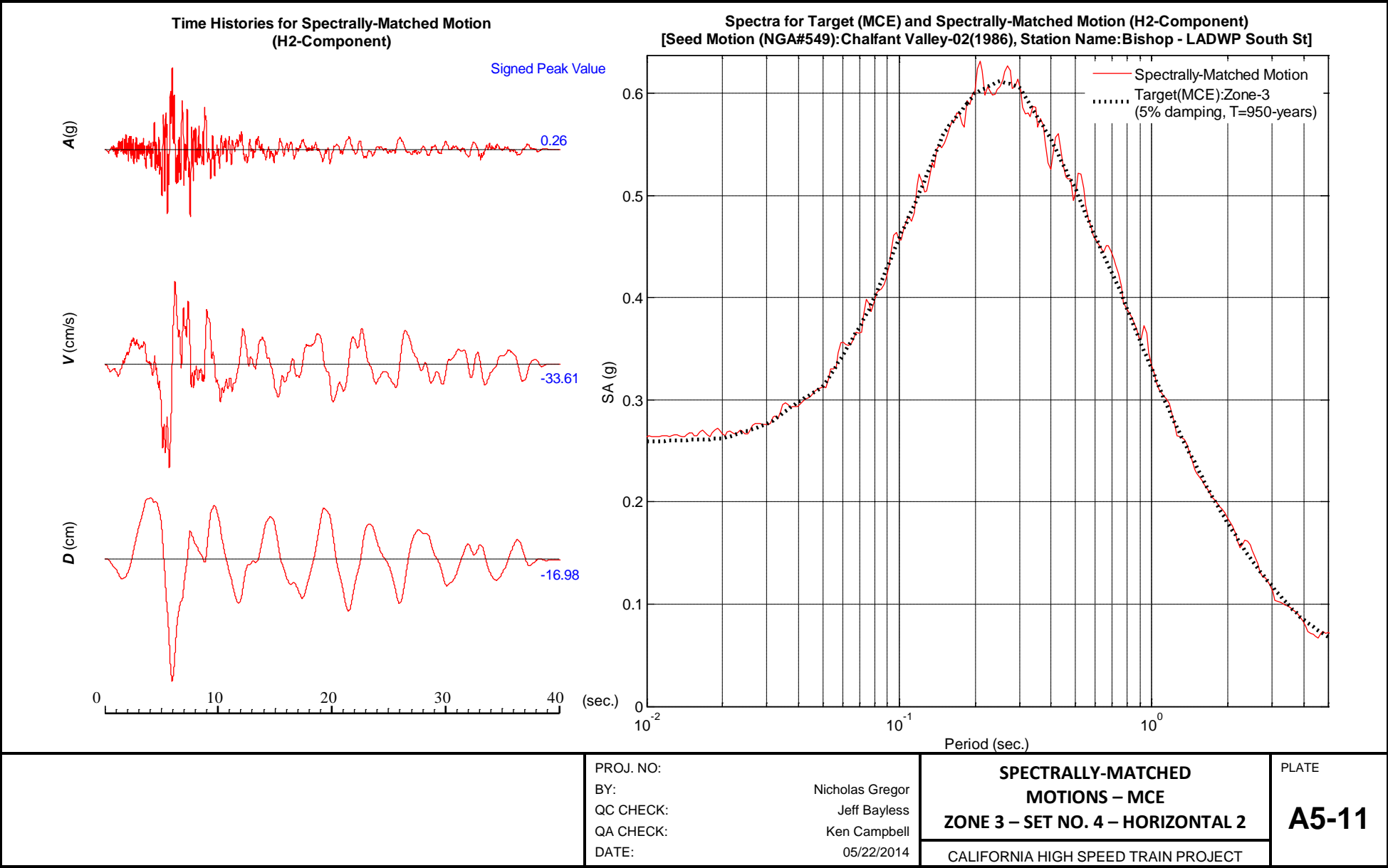


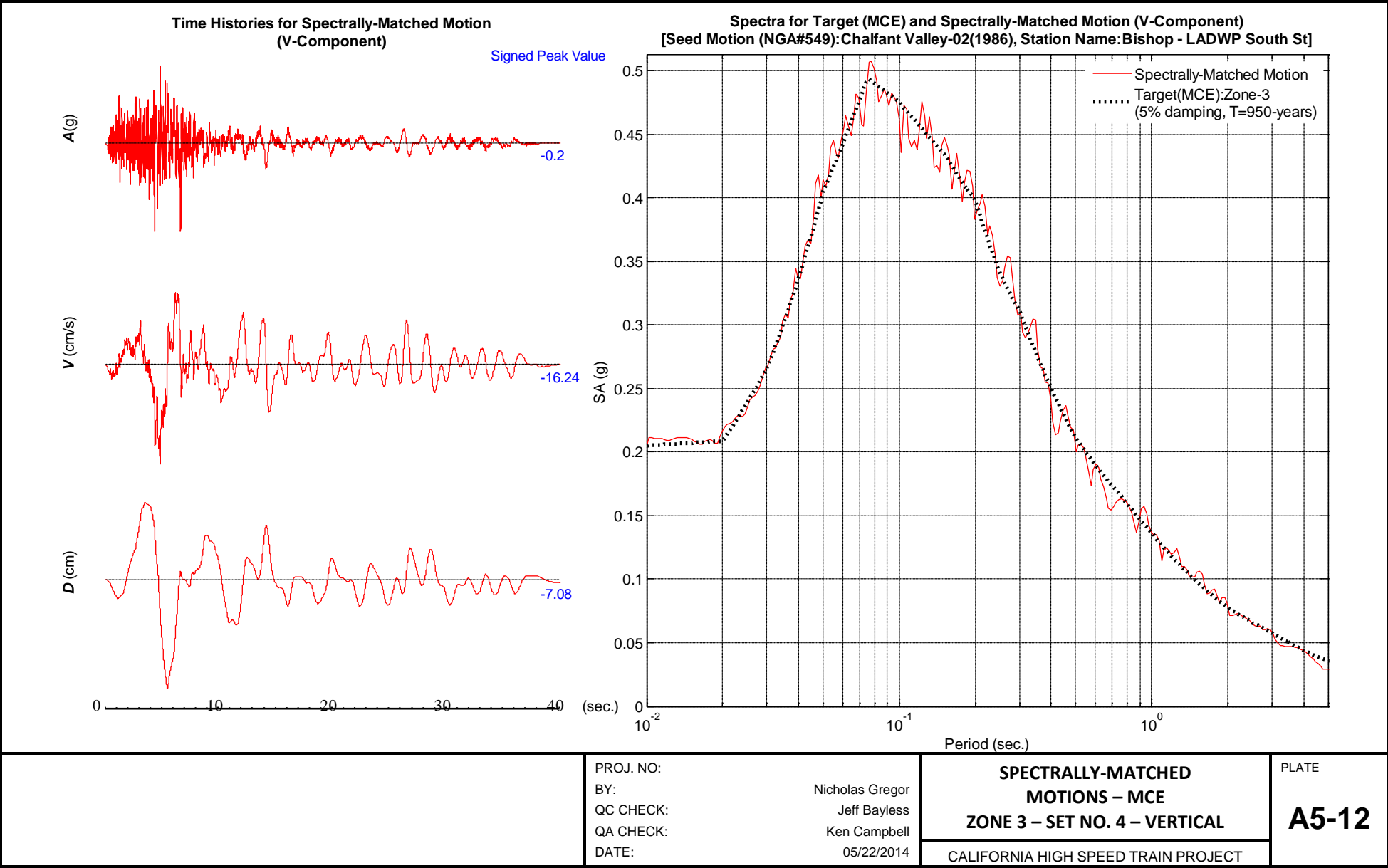


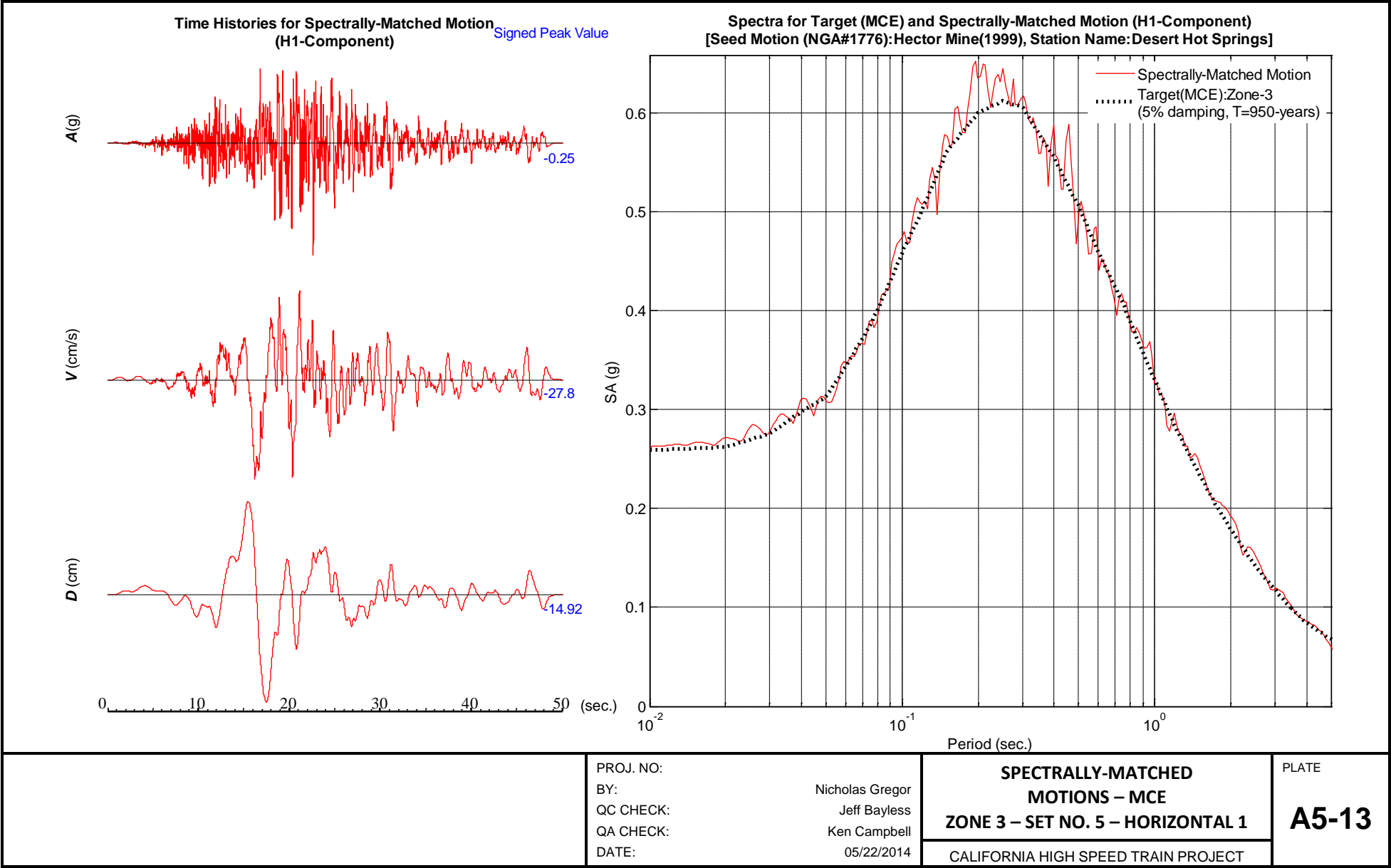






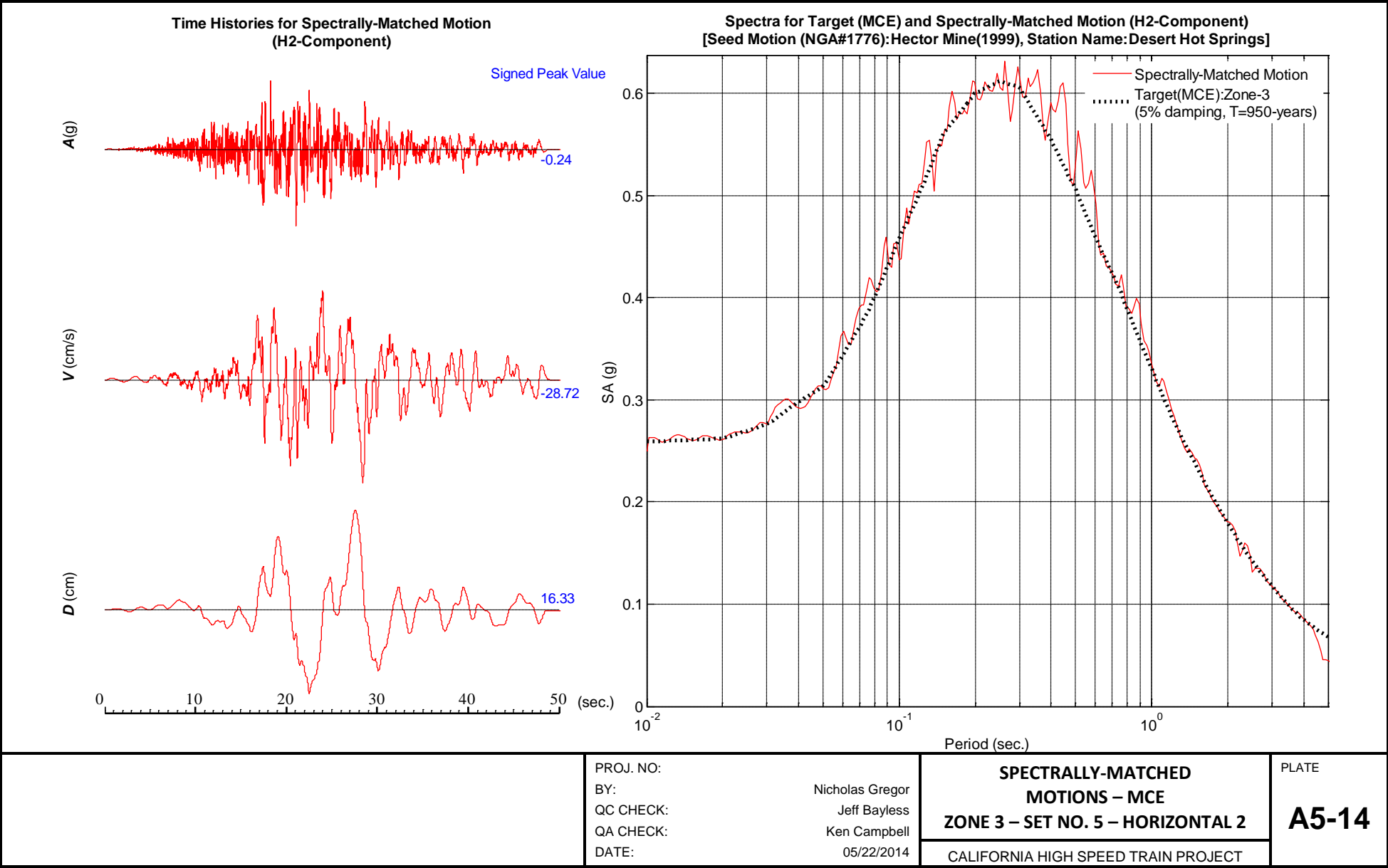


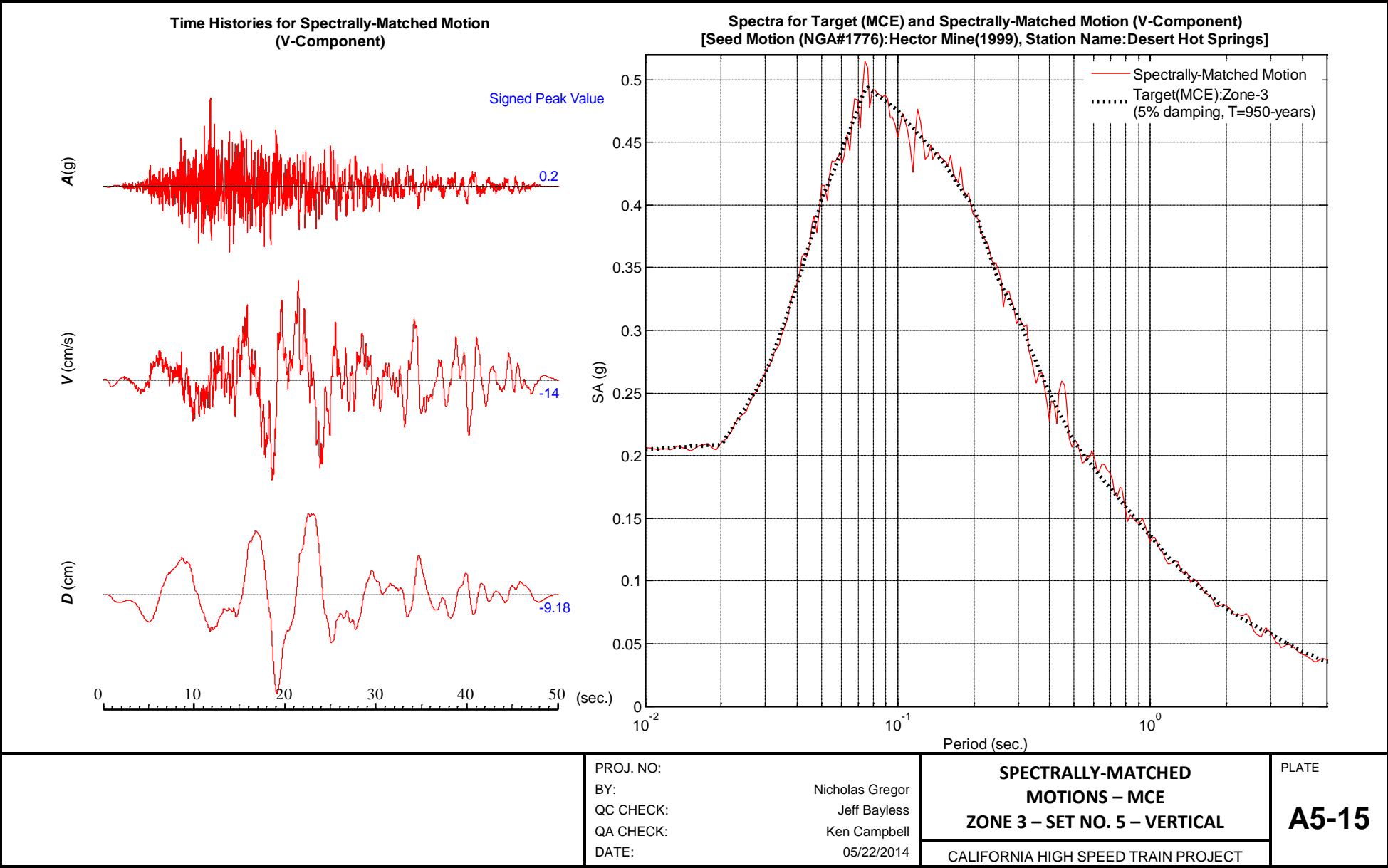


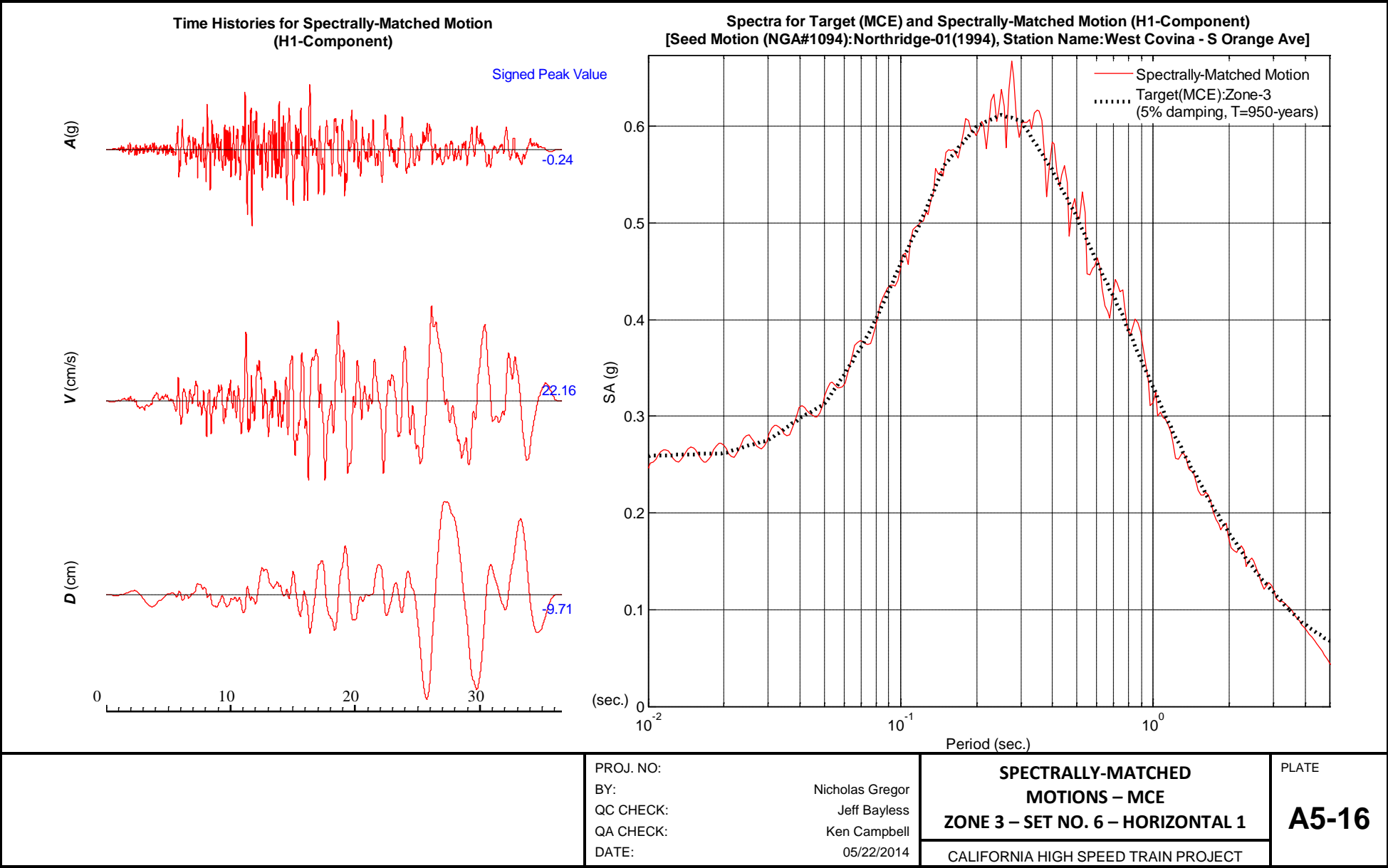


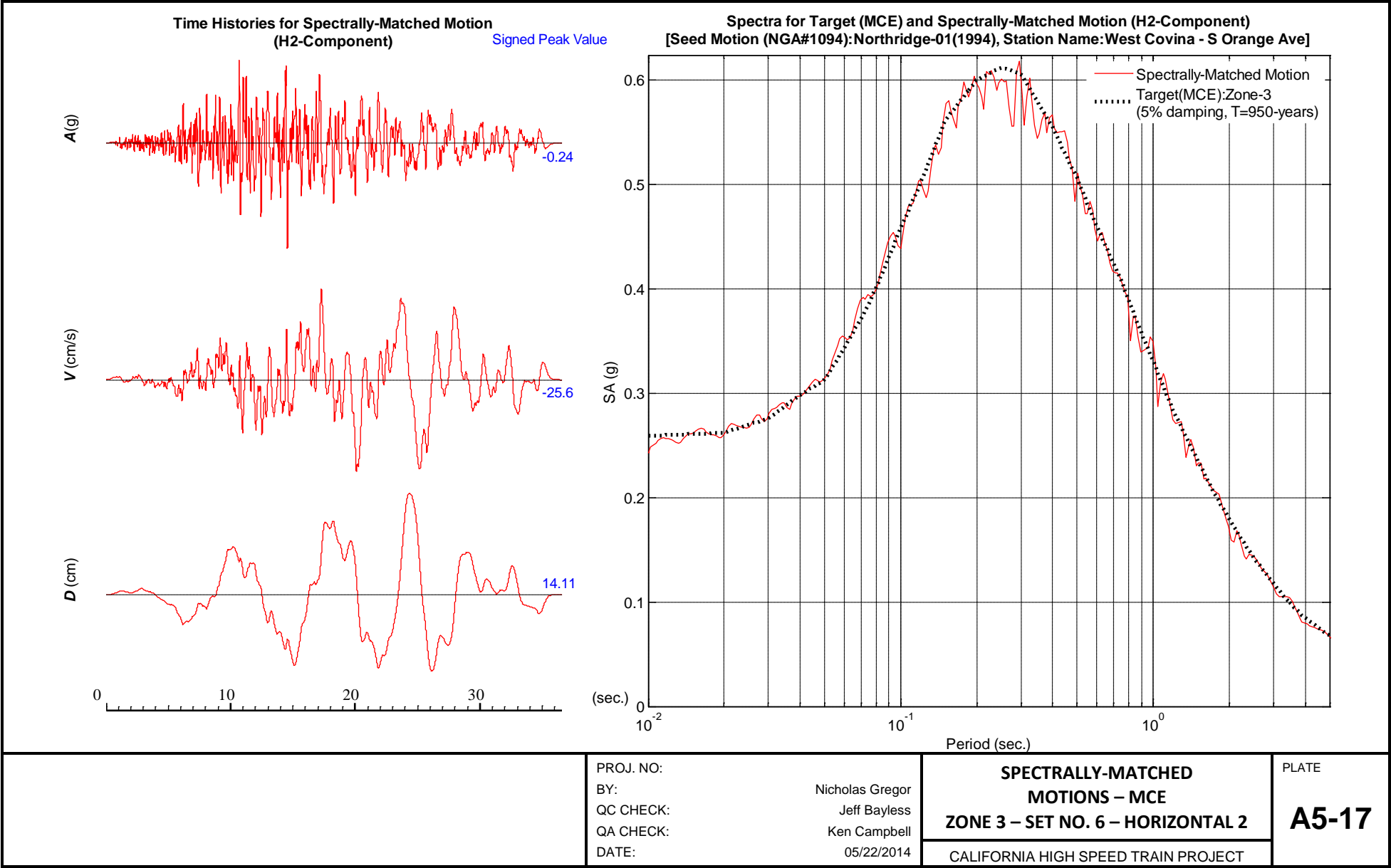
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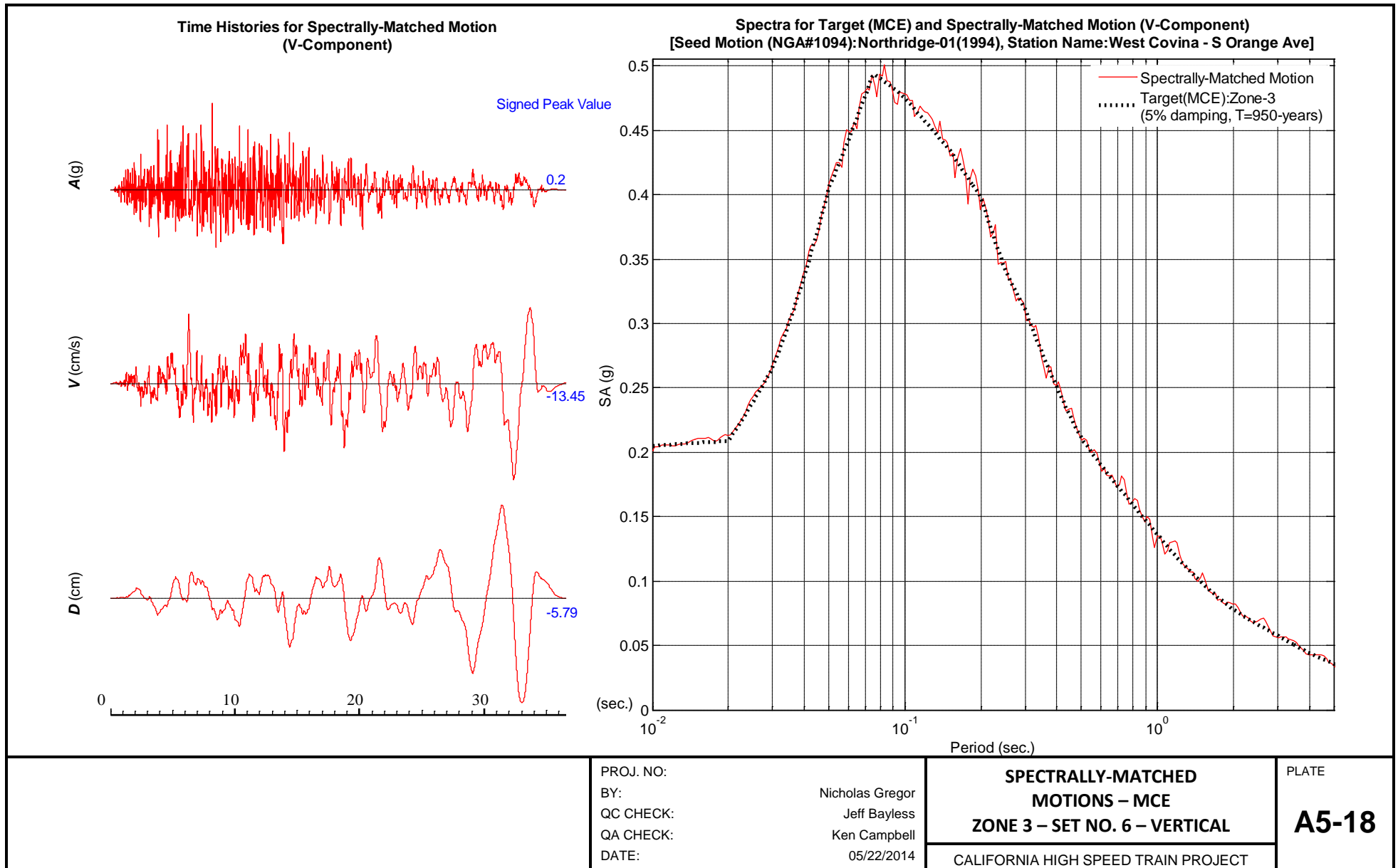


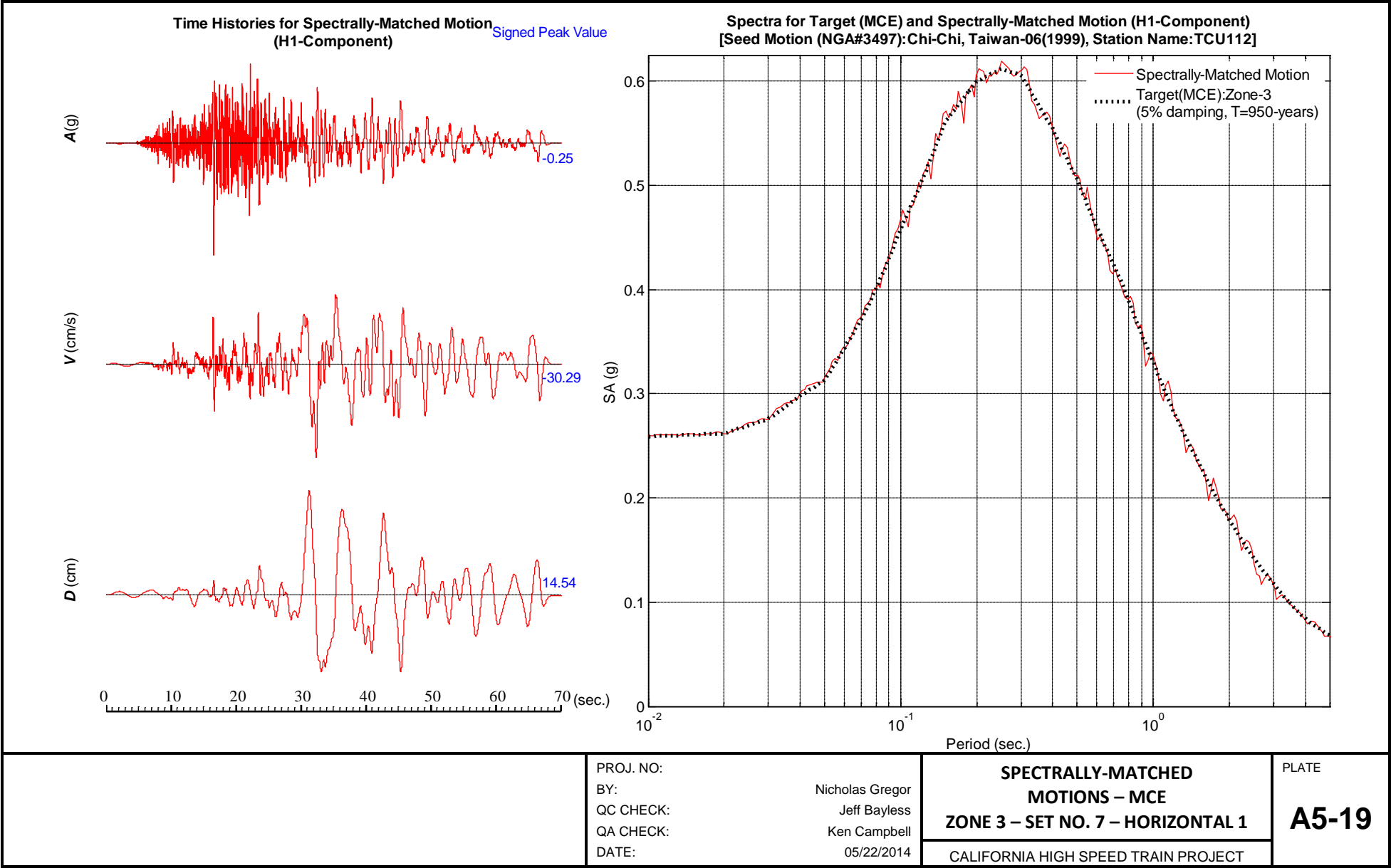


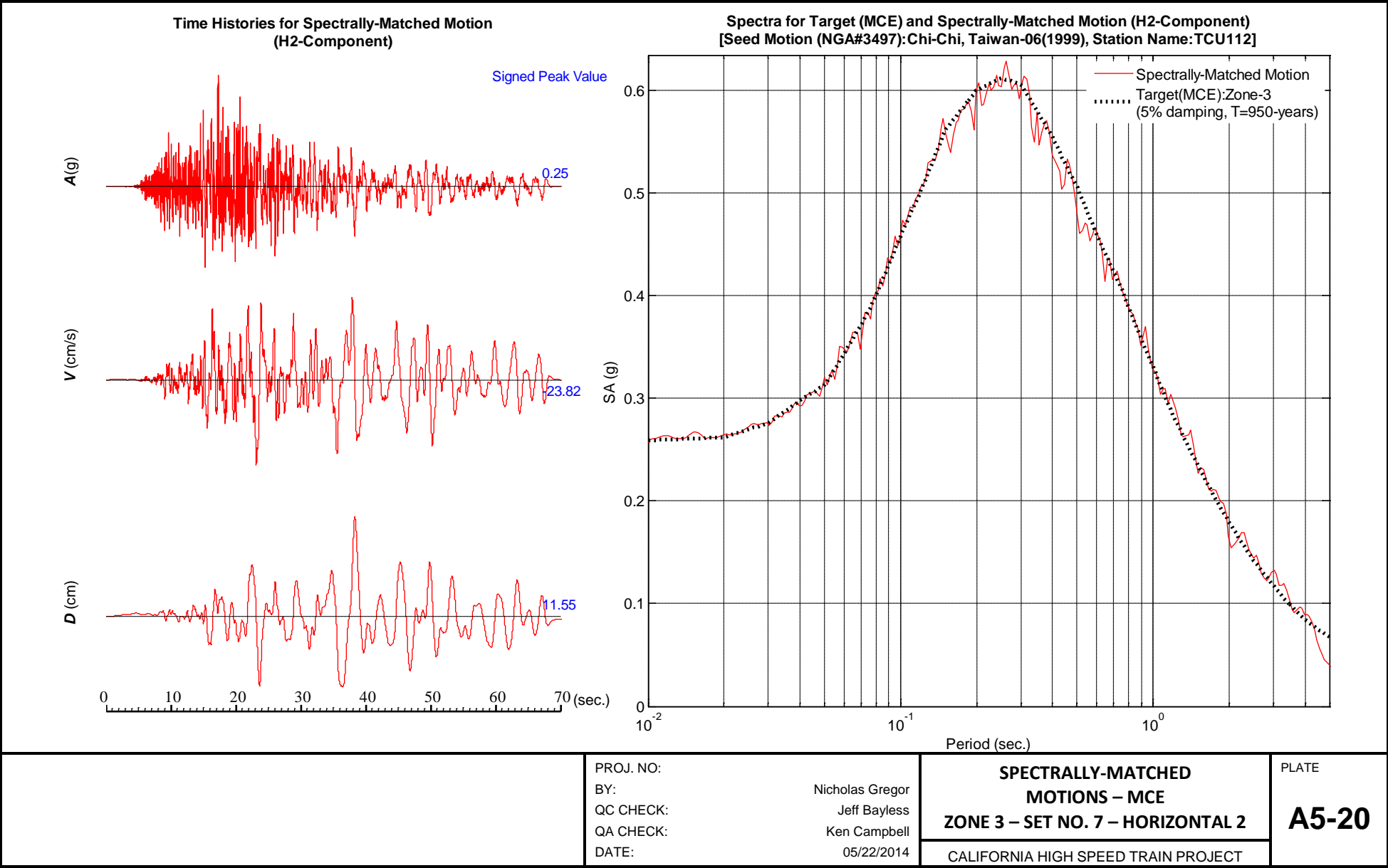


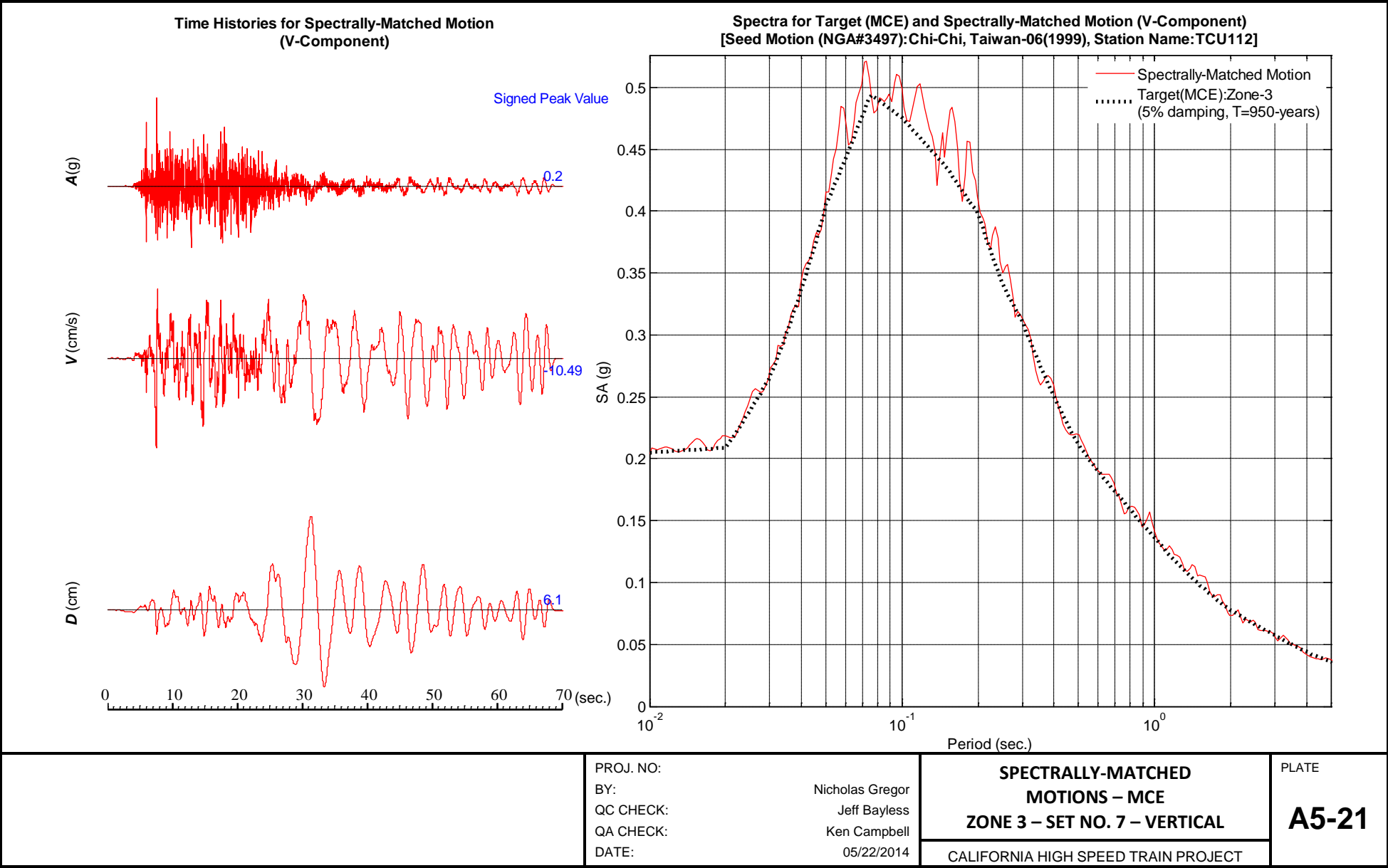














**Table C.1:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for Zone 4a**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.274	32.023	20.463	0.278	34.843	24.054	0.210	20.766	16.290
2	840	Landers	1992	Big Tujunga, Angeles Nat F	7.28	144.13	0.282	29.520	11.560	0.286	28.631	10.469	0.213	16.439	4.613
3	176	Imperial Valley-06	1979	El Centro Array #13	6.53	21.98	0.288	32.154	20.210	0.273	38.177	13.985	0.208	16.644	7.371
4	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.268	33.923	16.510	0.287	39.511	18.813	0.215	18.954	8.852
5	1776	Hector Mine	1999	Desert Hot Springs	7.13	56.40	0.280	32.593	17.827	0.280	32.438	18.680	0.215	15.846	10.683
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.270	25.265	11.545	0.269	29.620	17.279	0.211	15.373	6.625
7	3497	Chi-Chi, Taiwan-06	1999	TCU112	6.30	51.72	0.285	34.217	16.523	0.284	26.095	13.188	0.208	11.190	6.943

PROJ. NO:

BY:

QC CHECK:

QA CHECK:

DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

05/30/2014

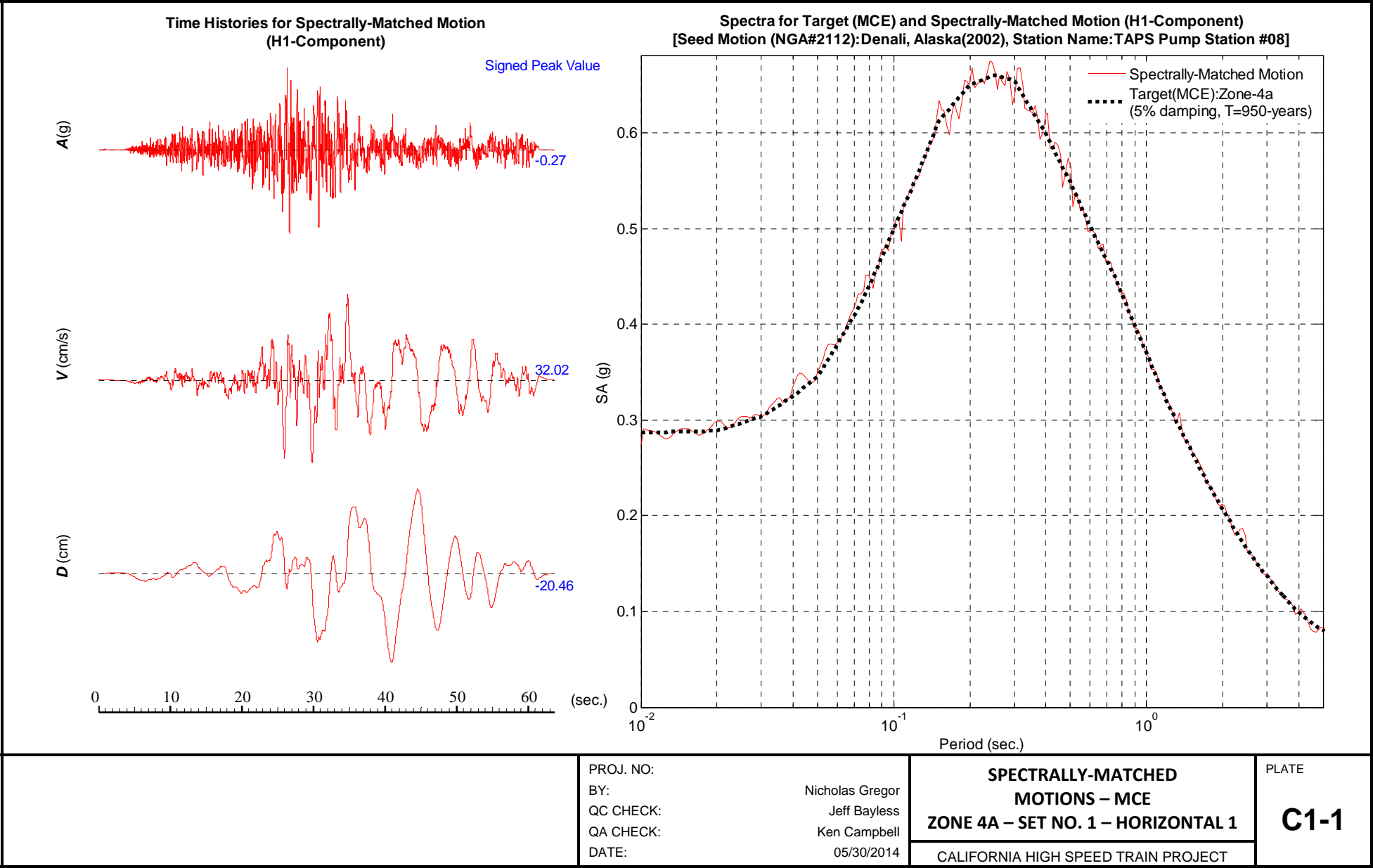
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
MCE – ZONE 4A**

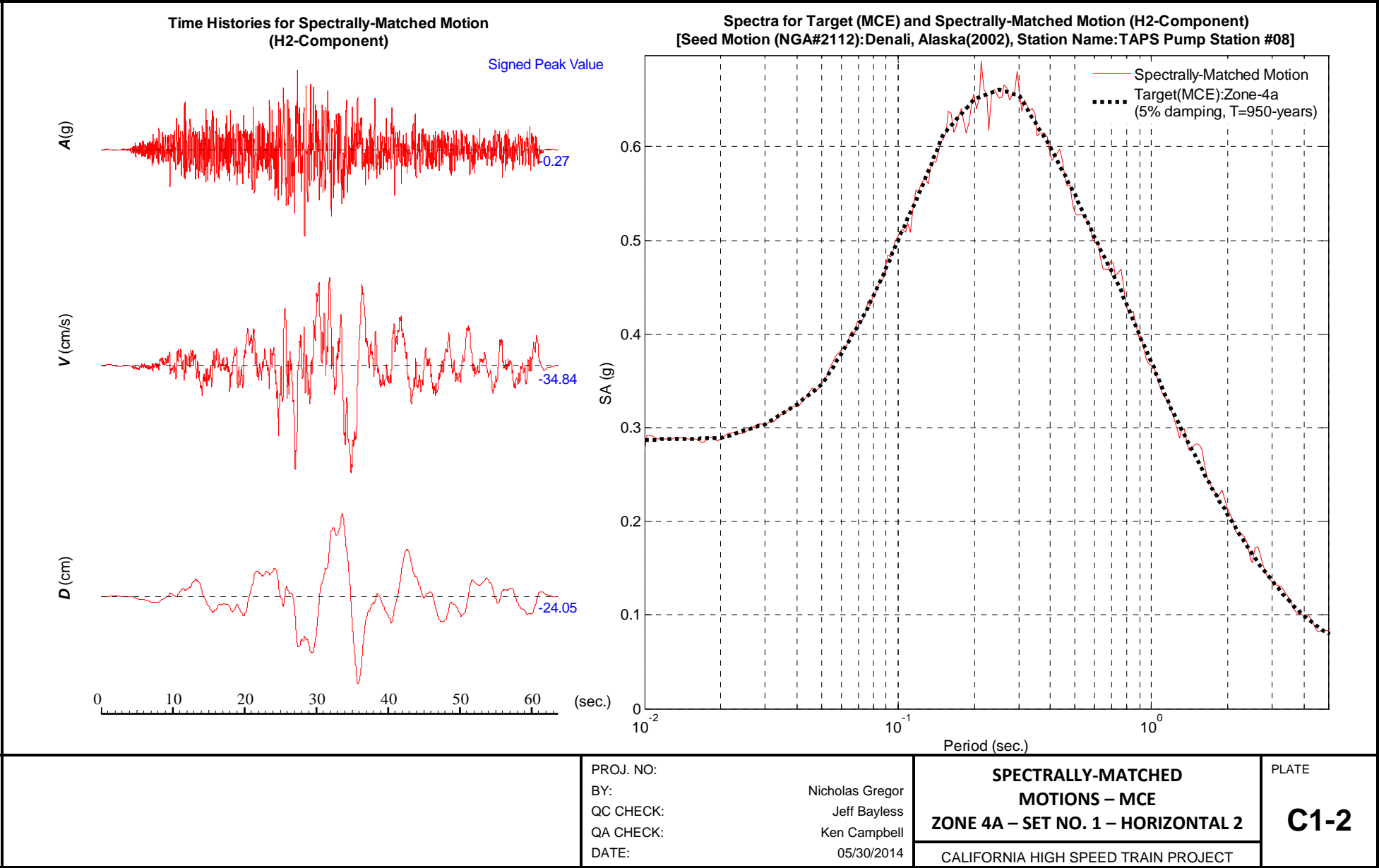
CALIFORNIA HIGH SPEED TRAIN PROJECT

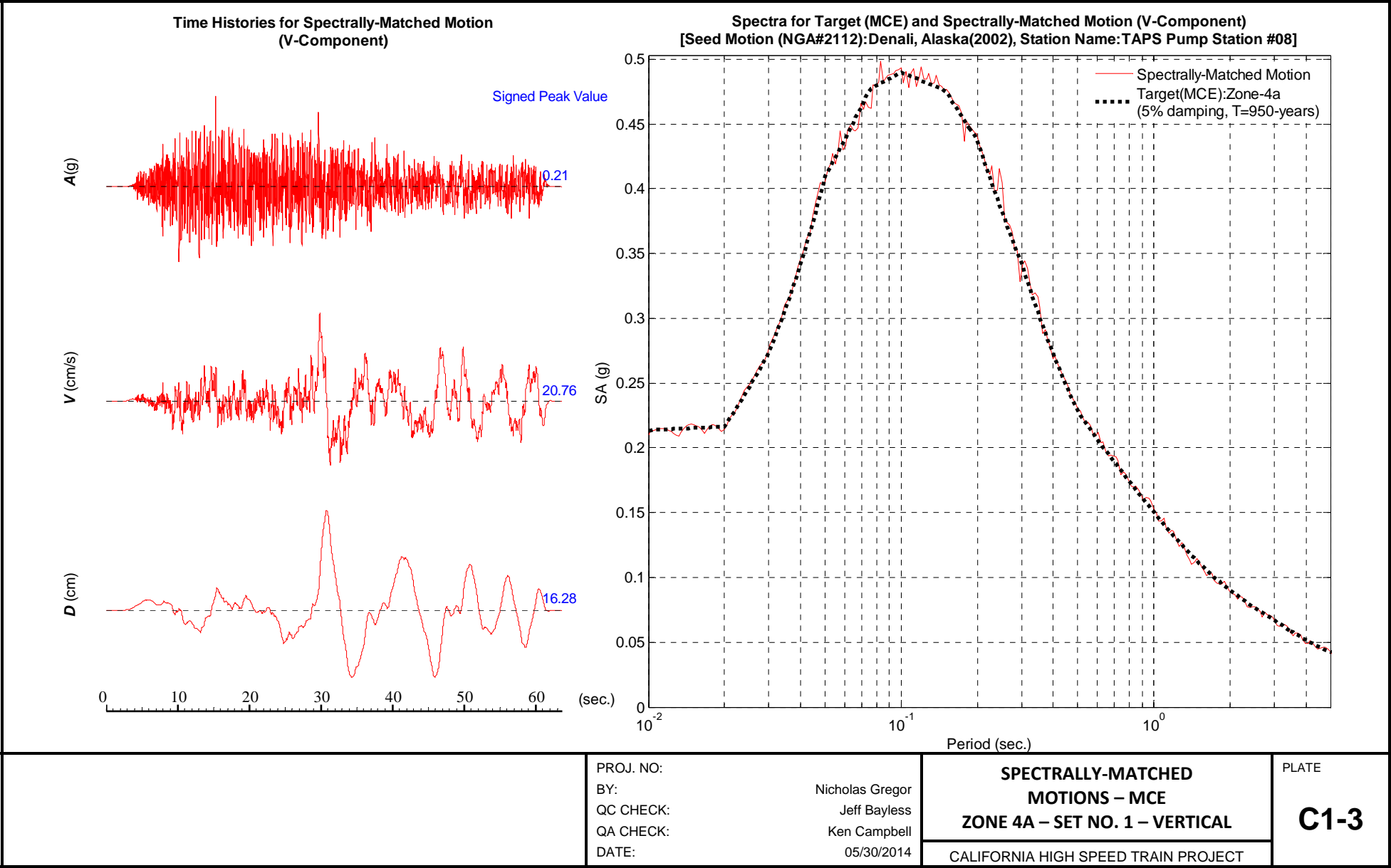
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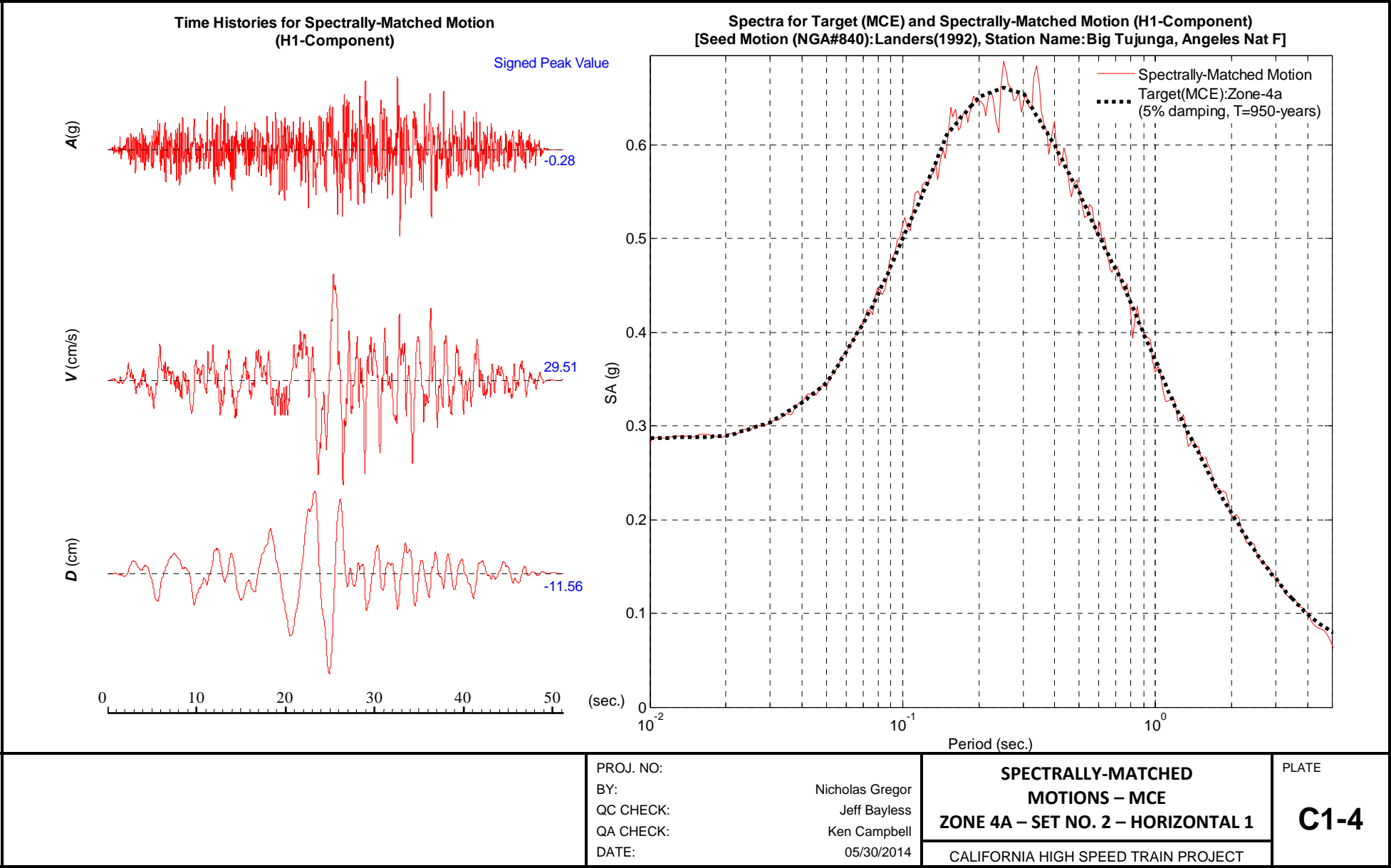
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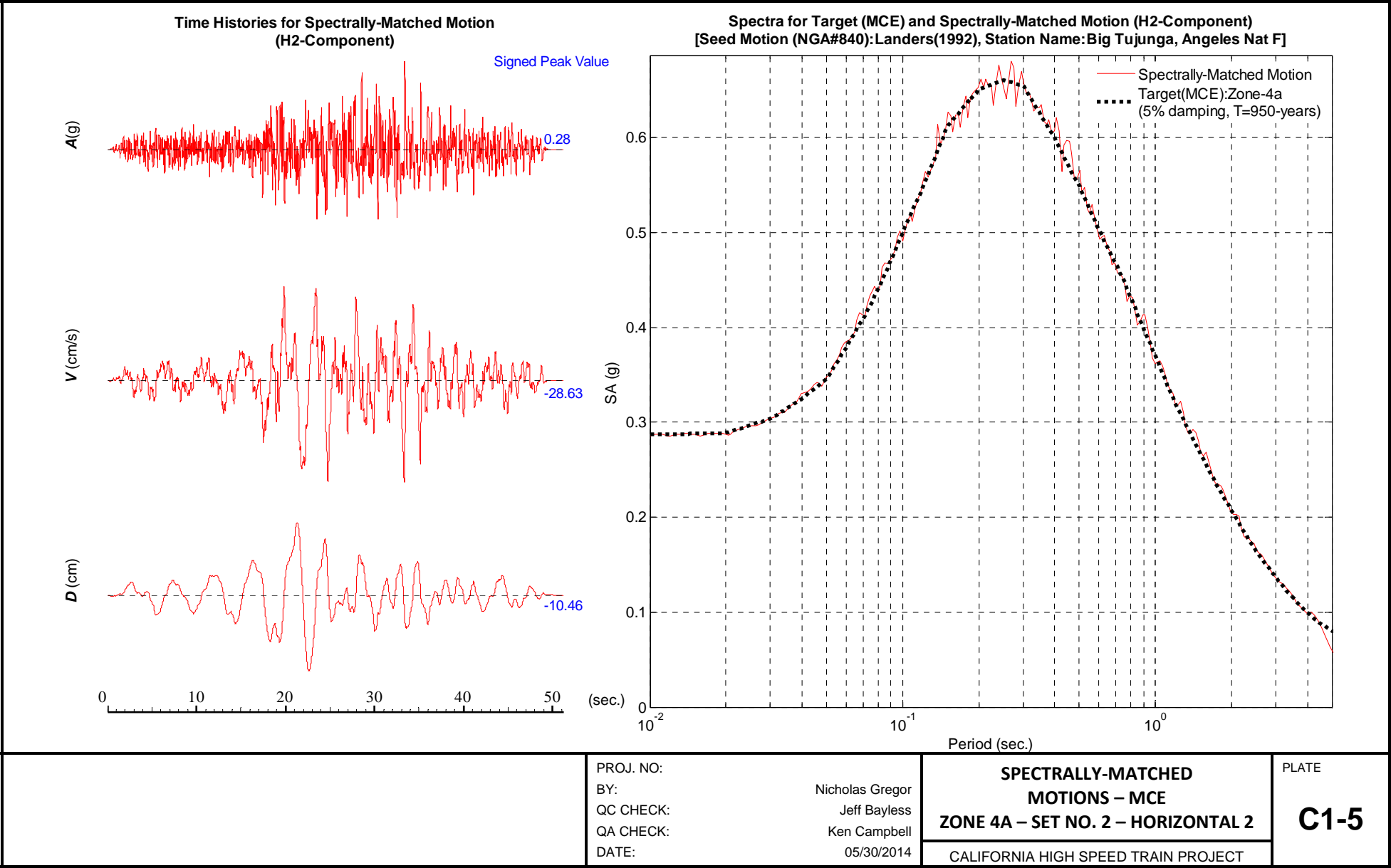
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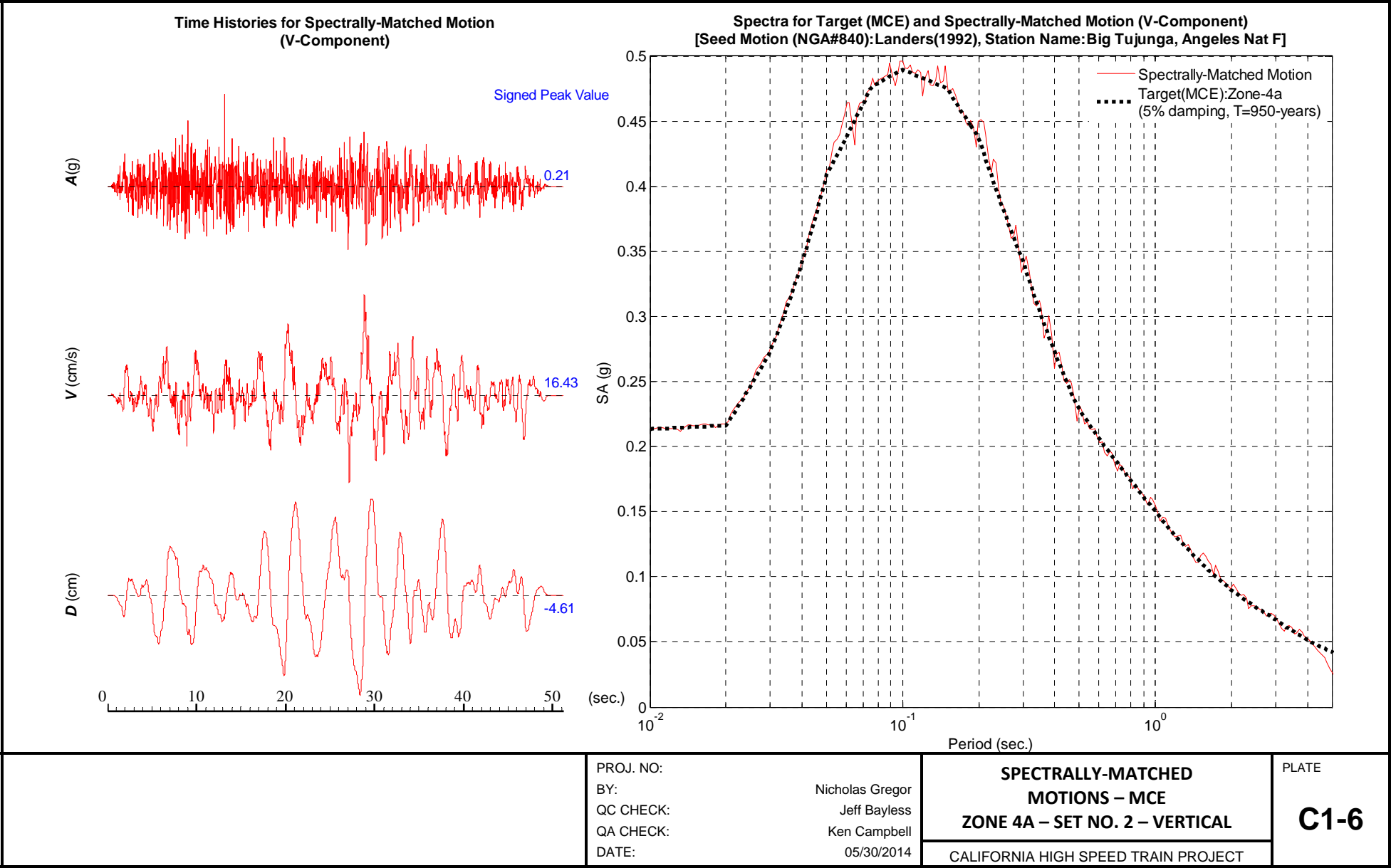






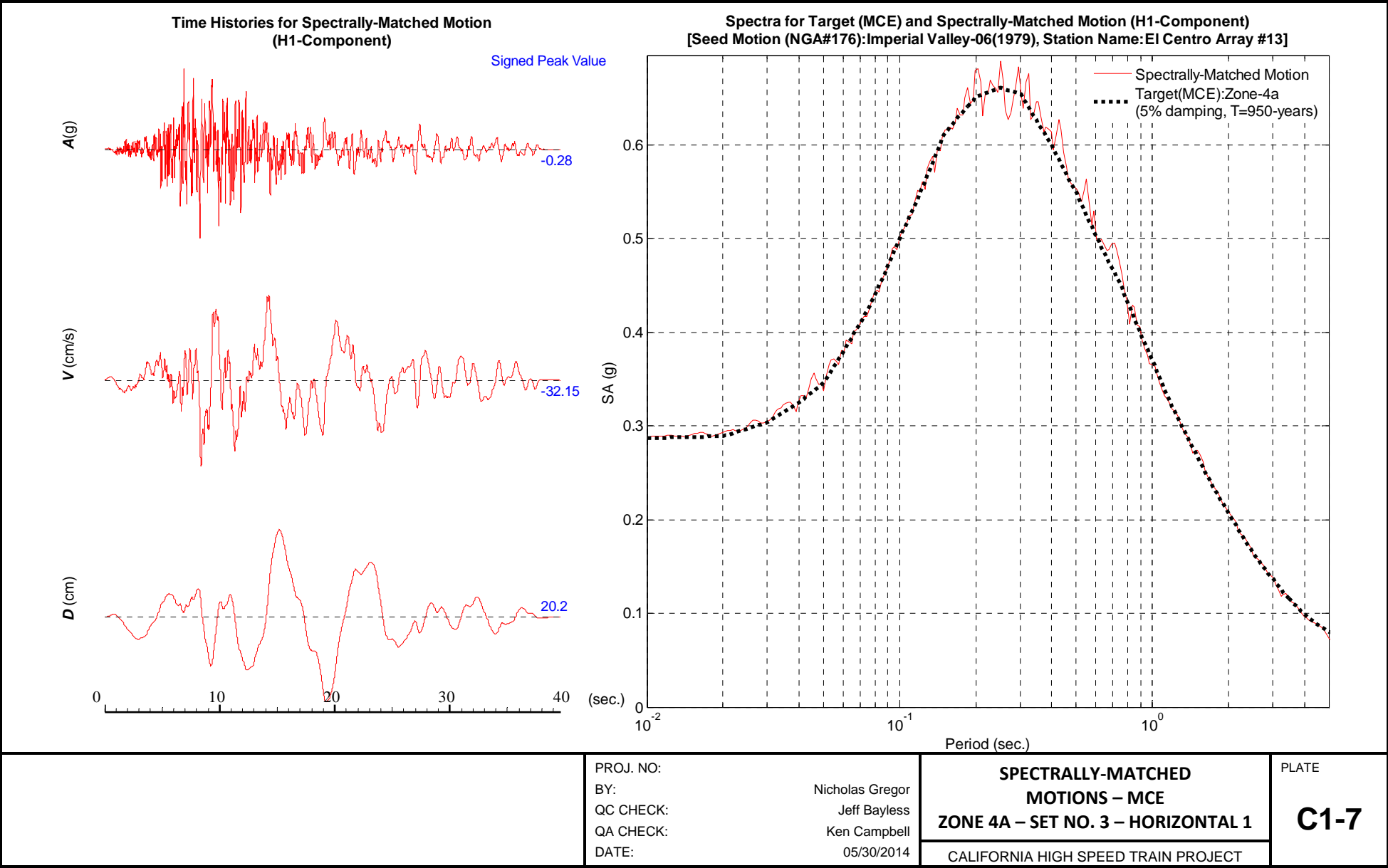


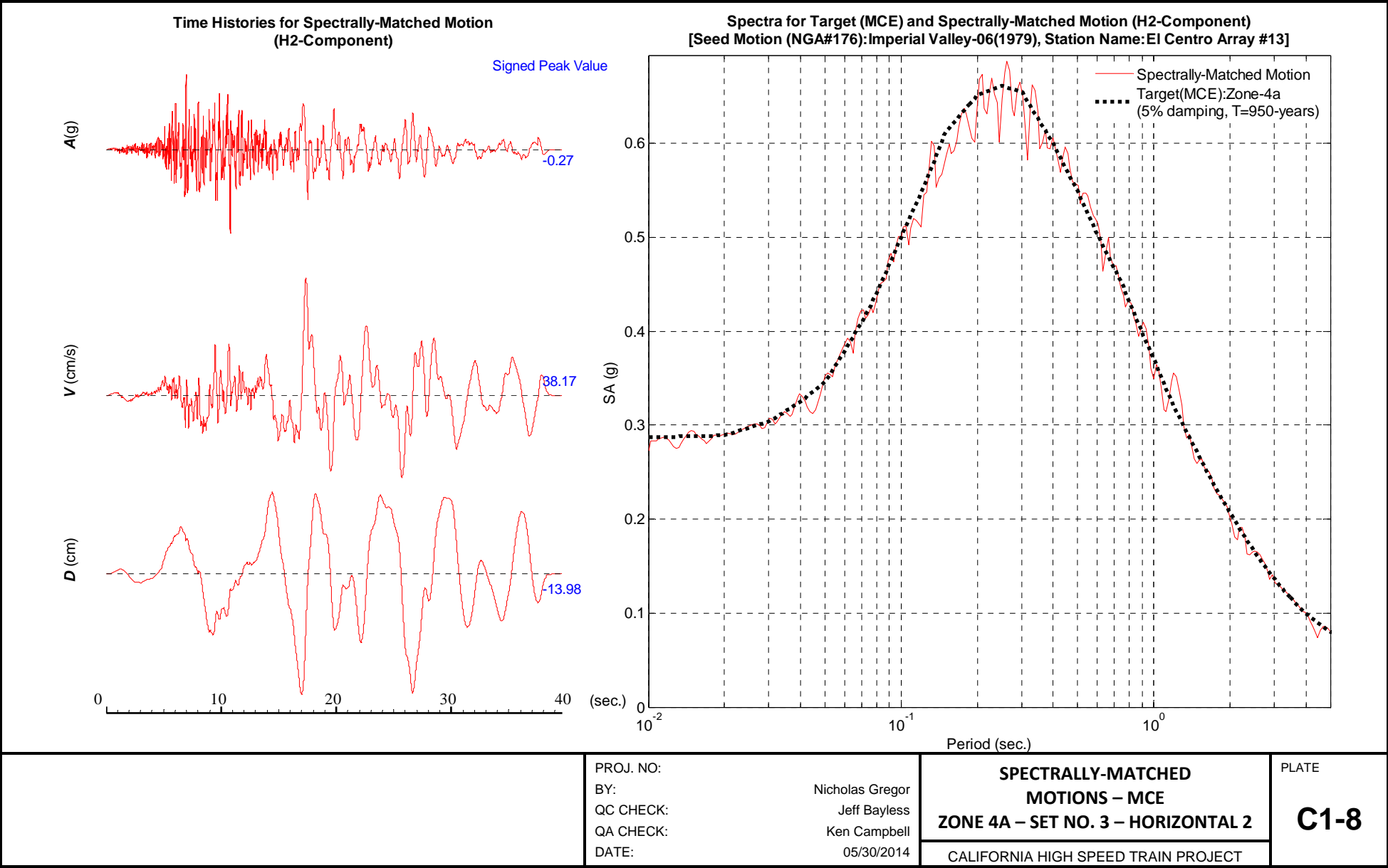
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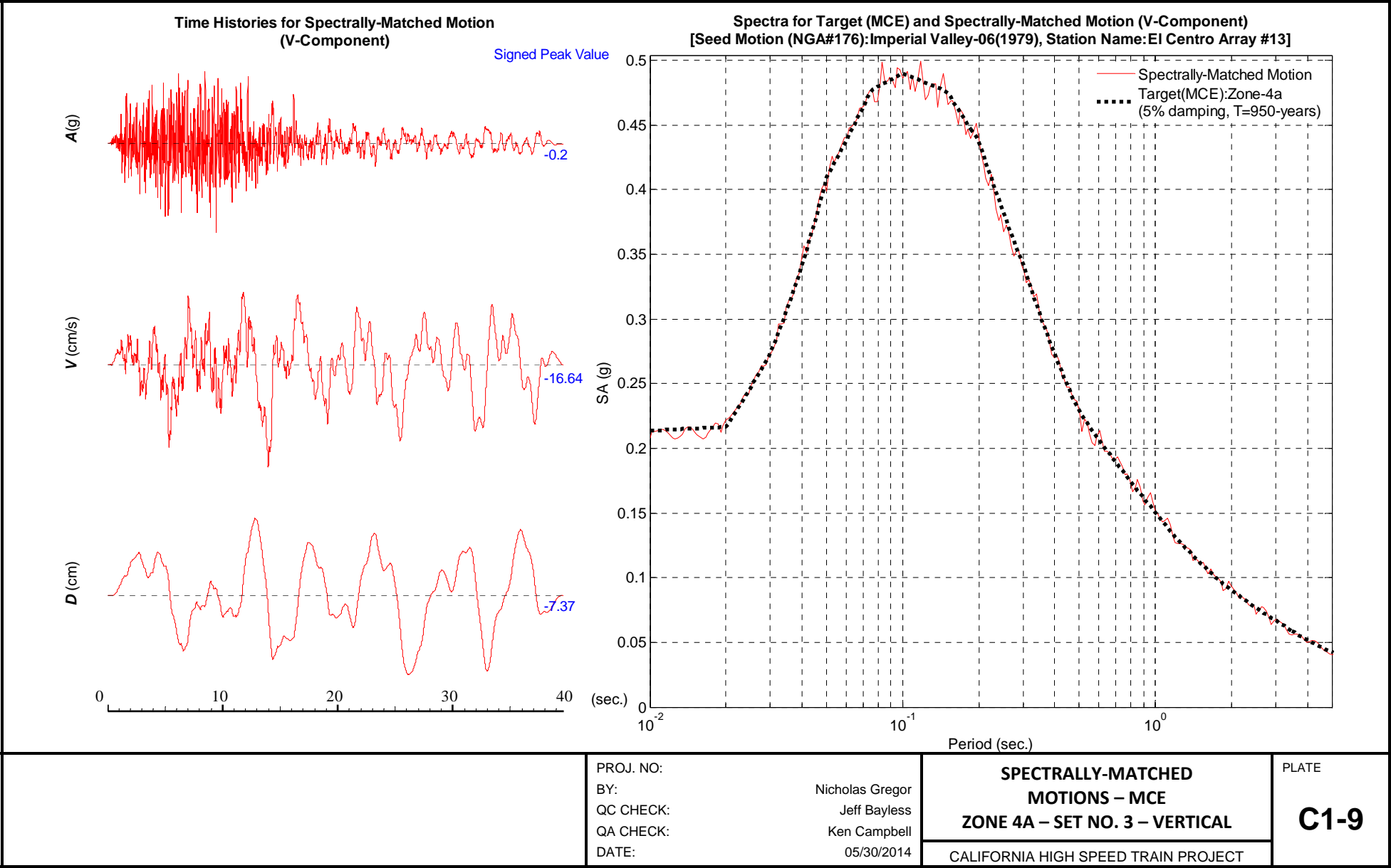


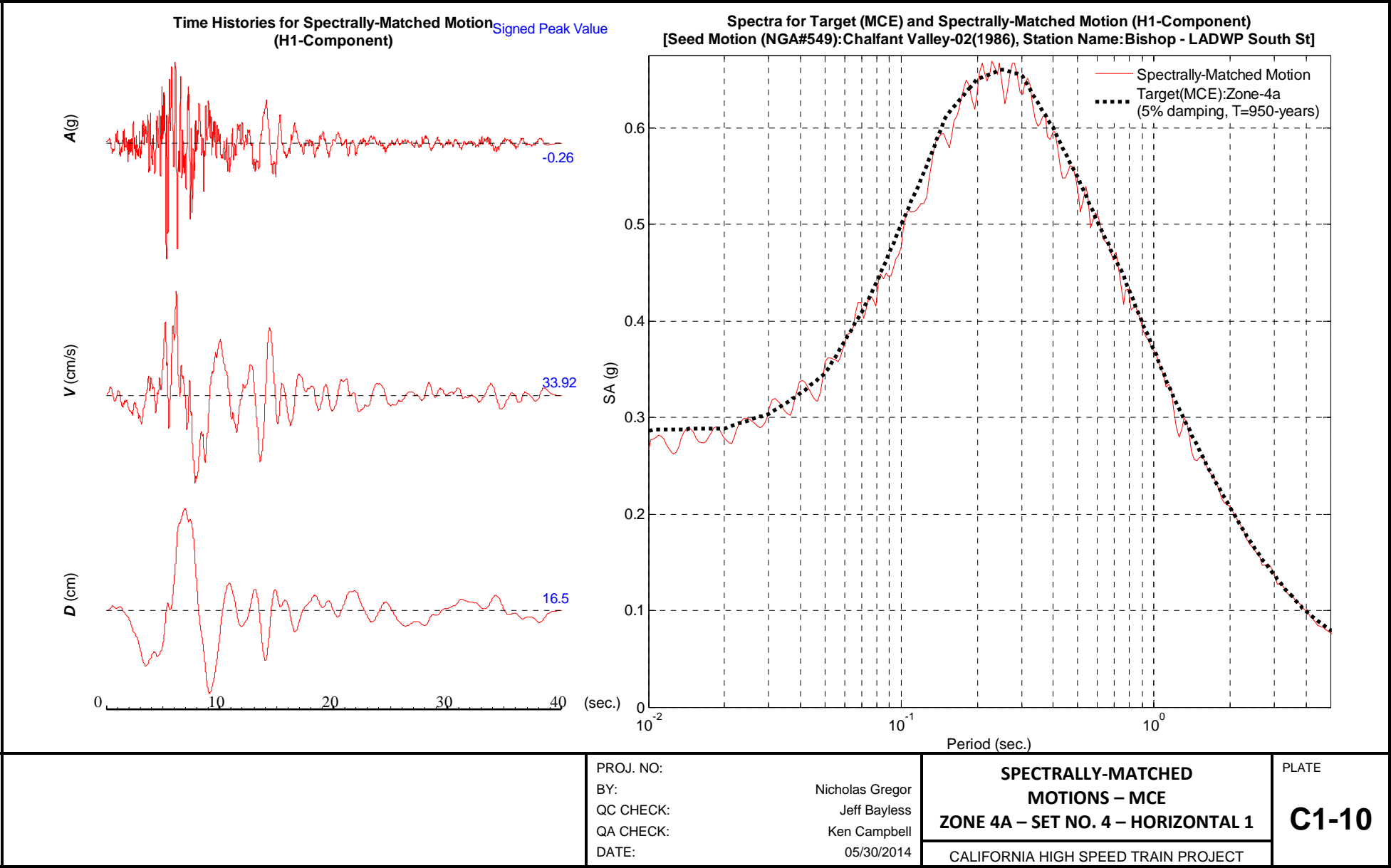
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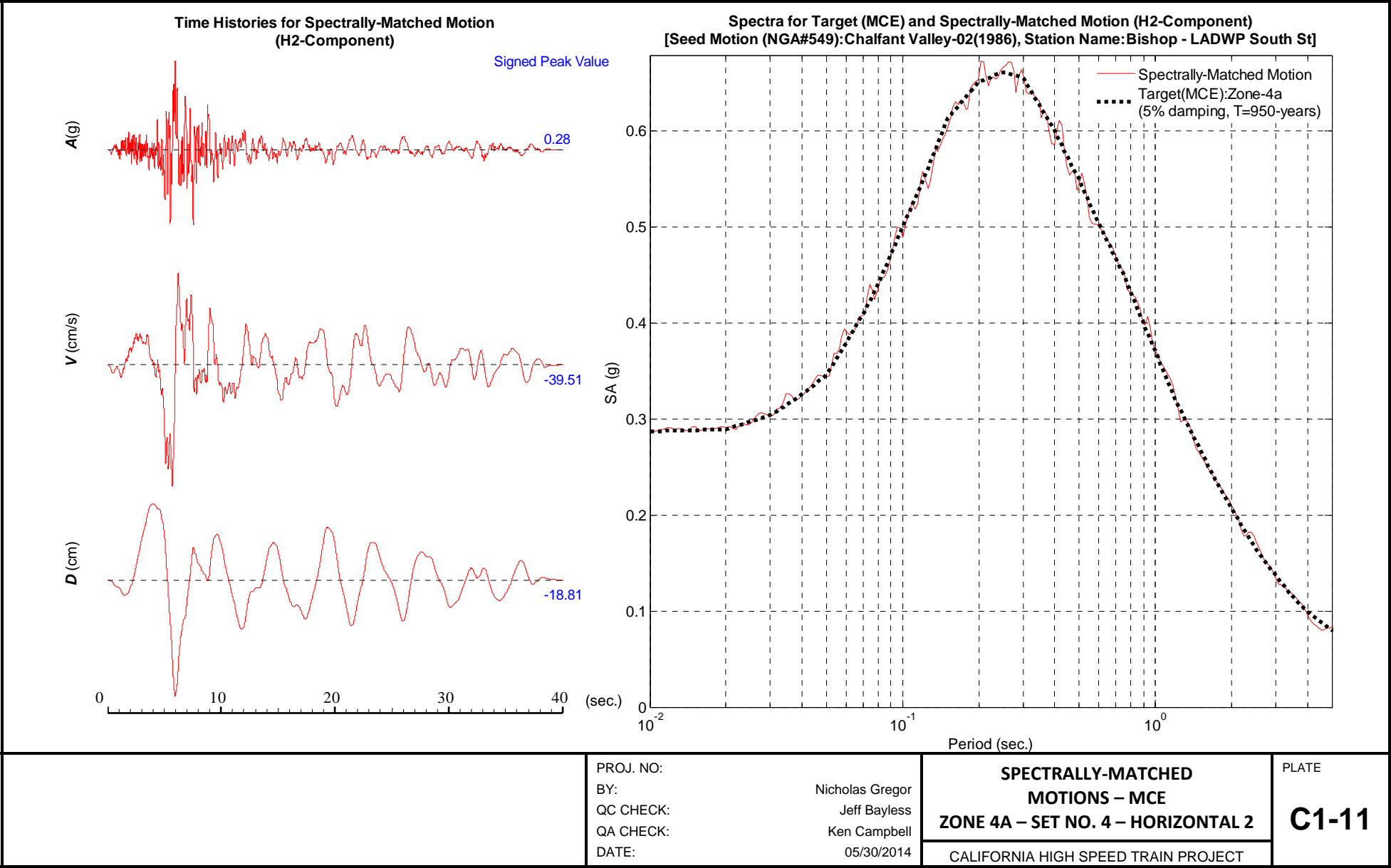


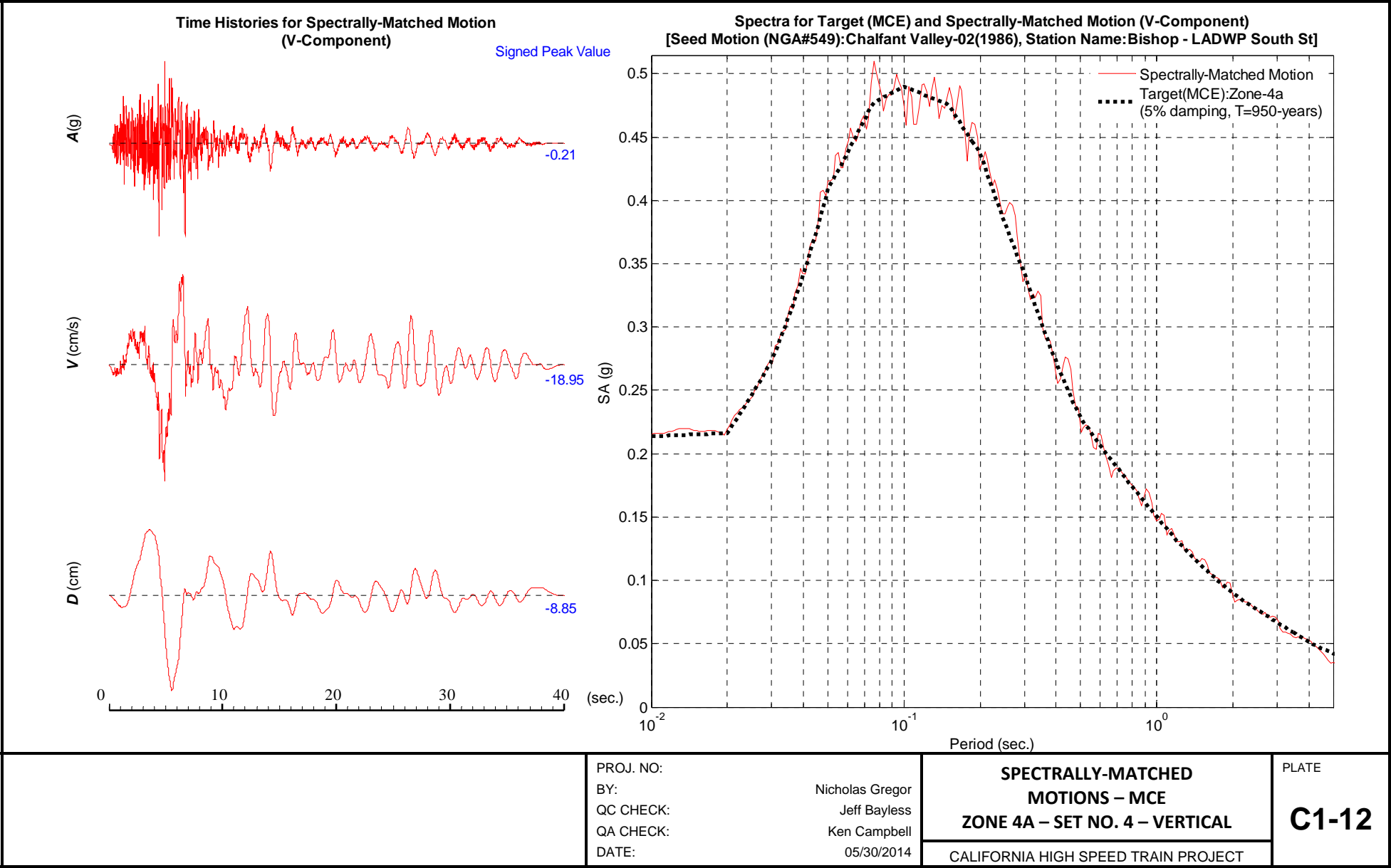


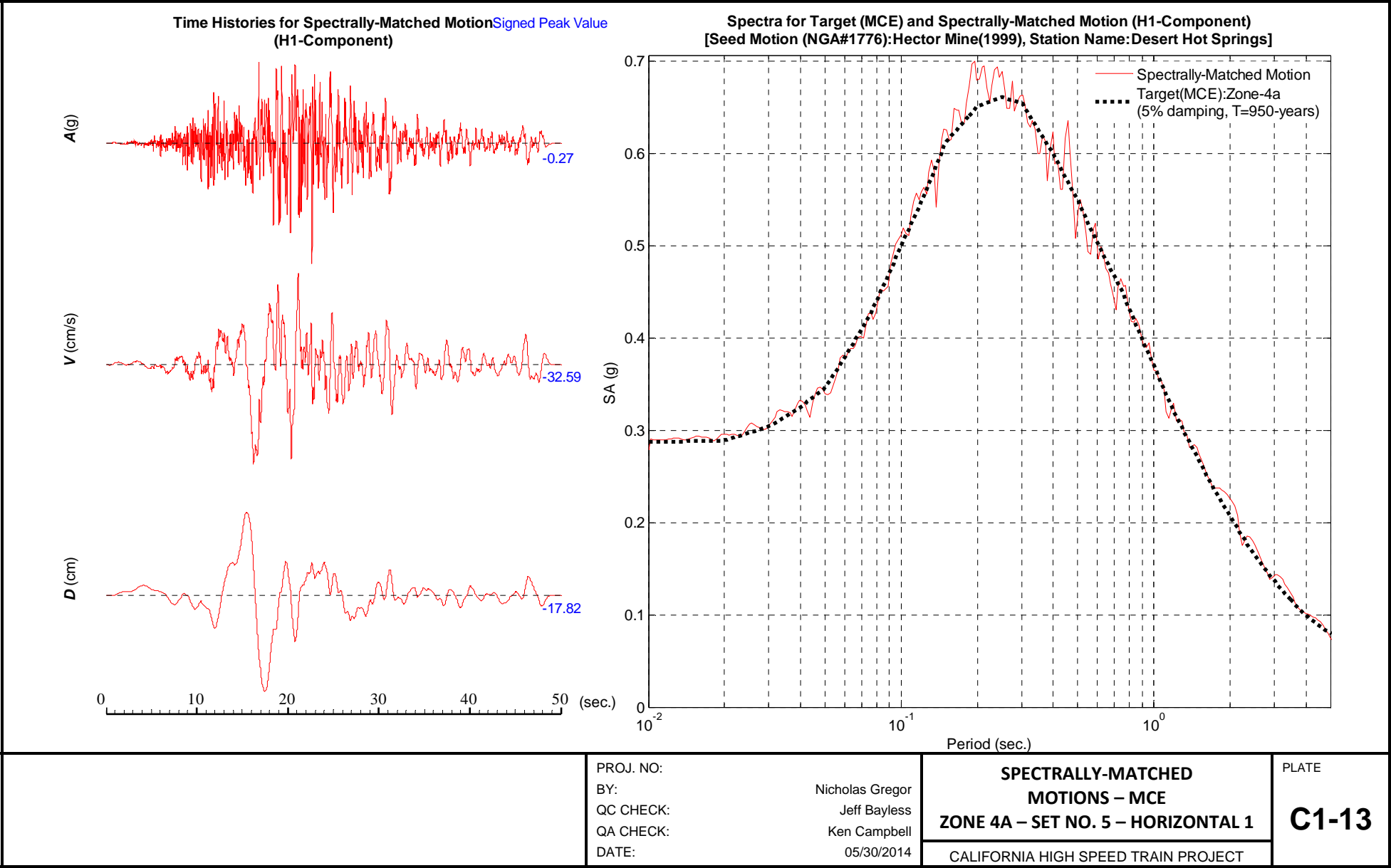




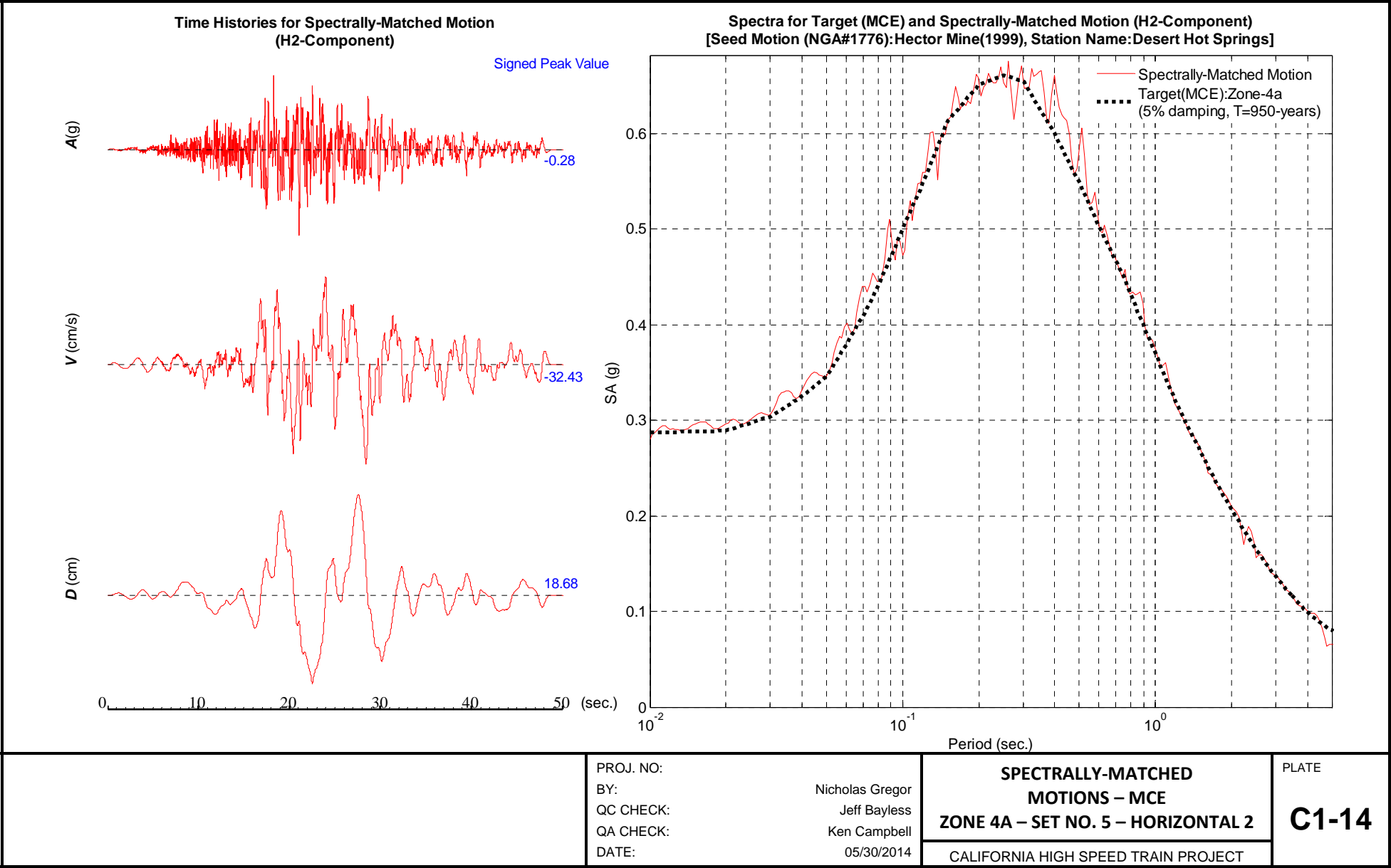
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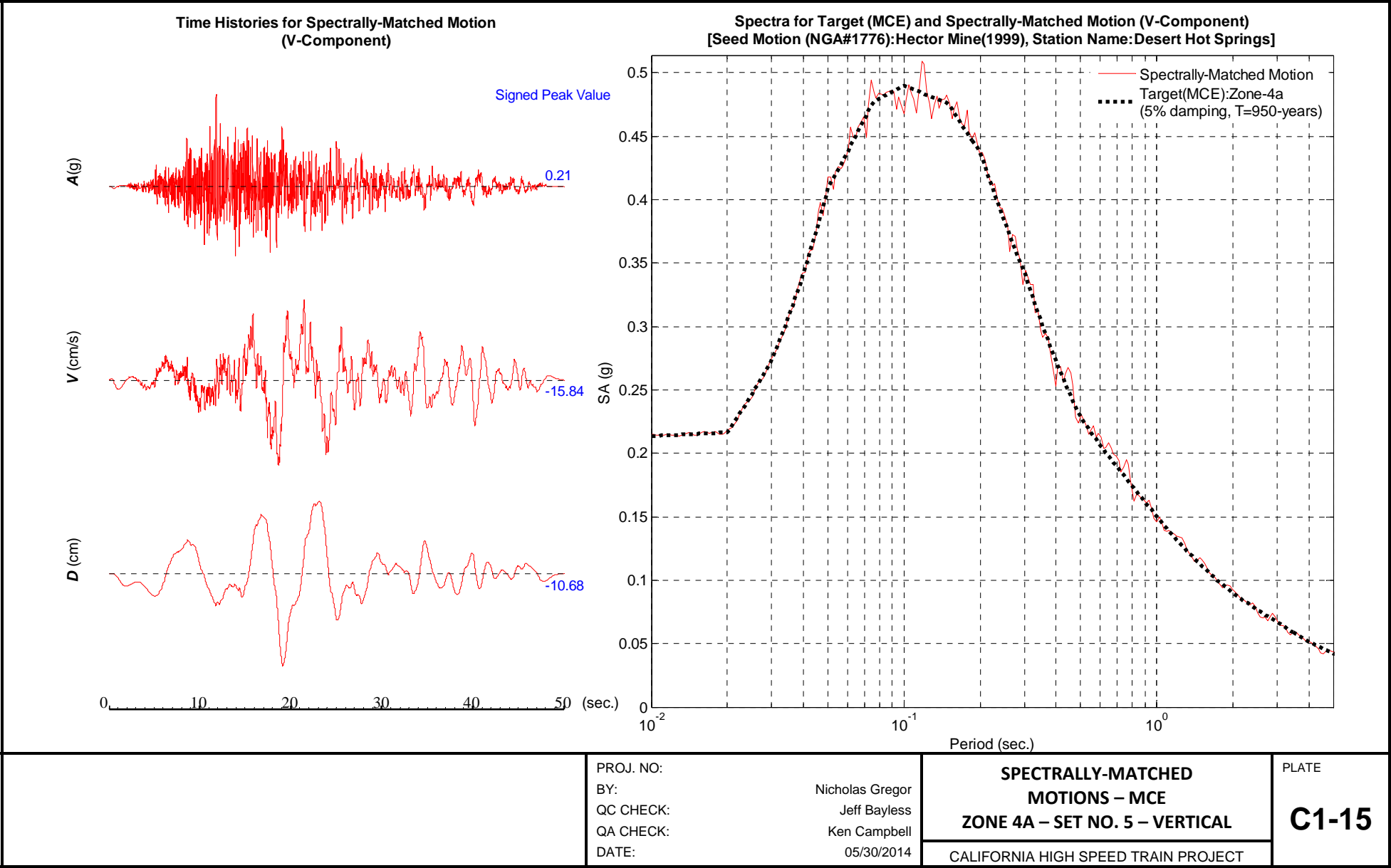


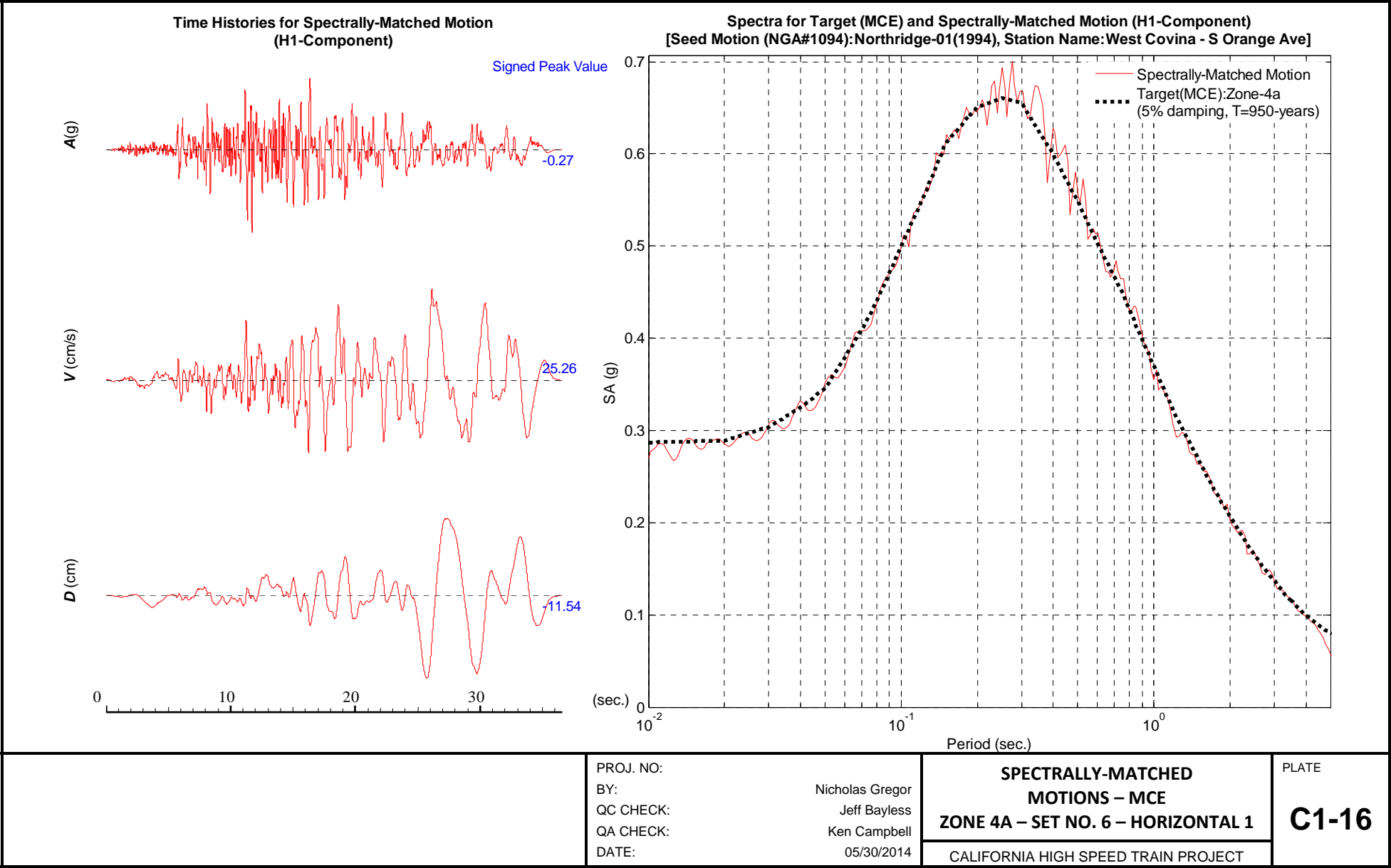


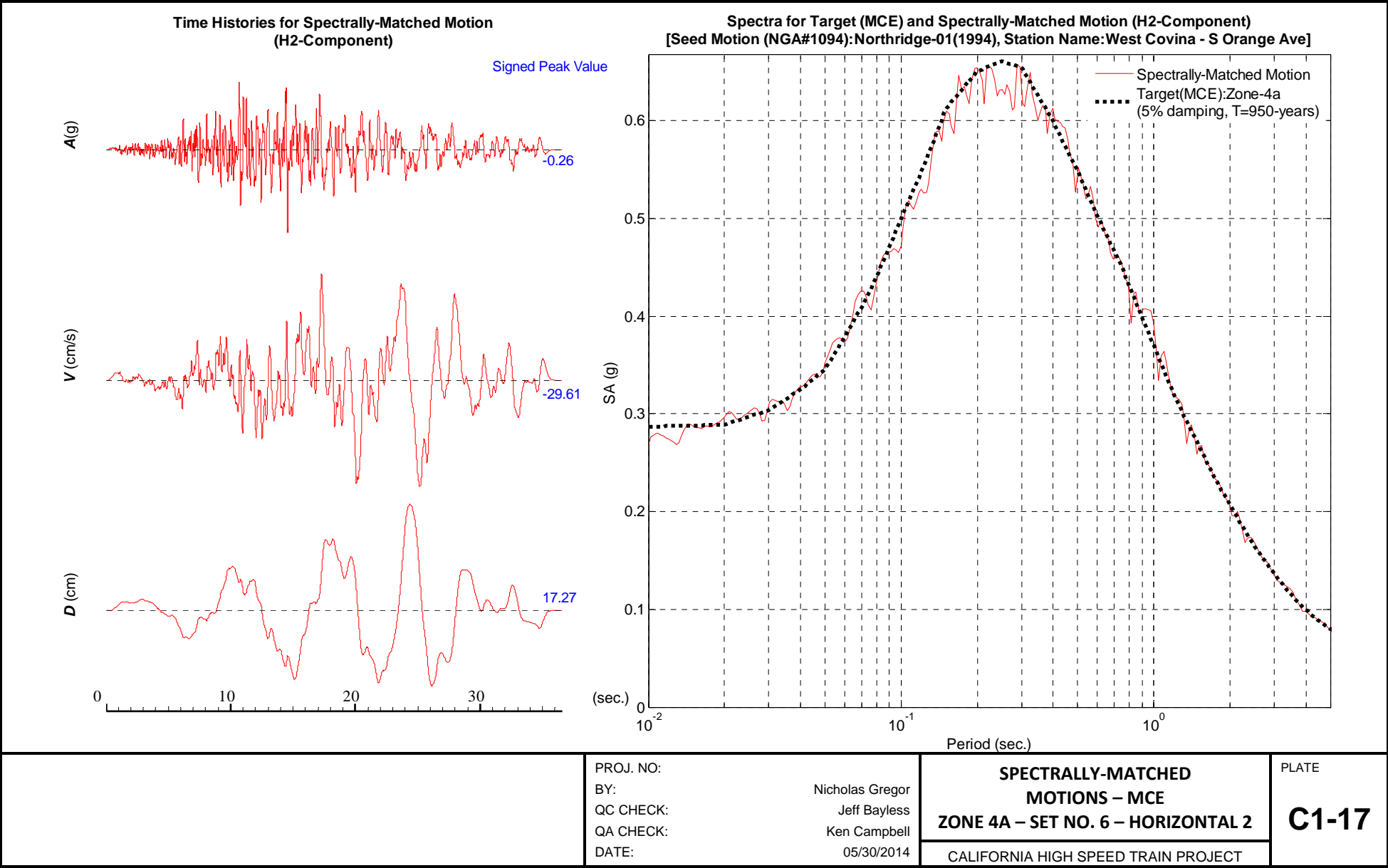


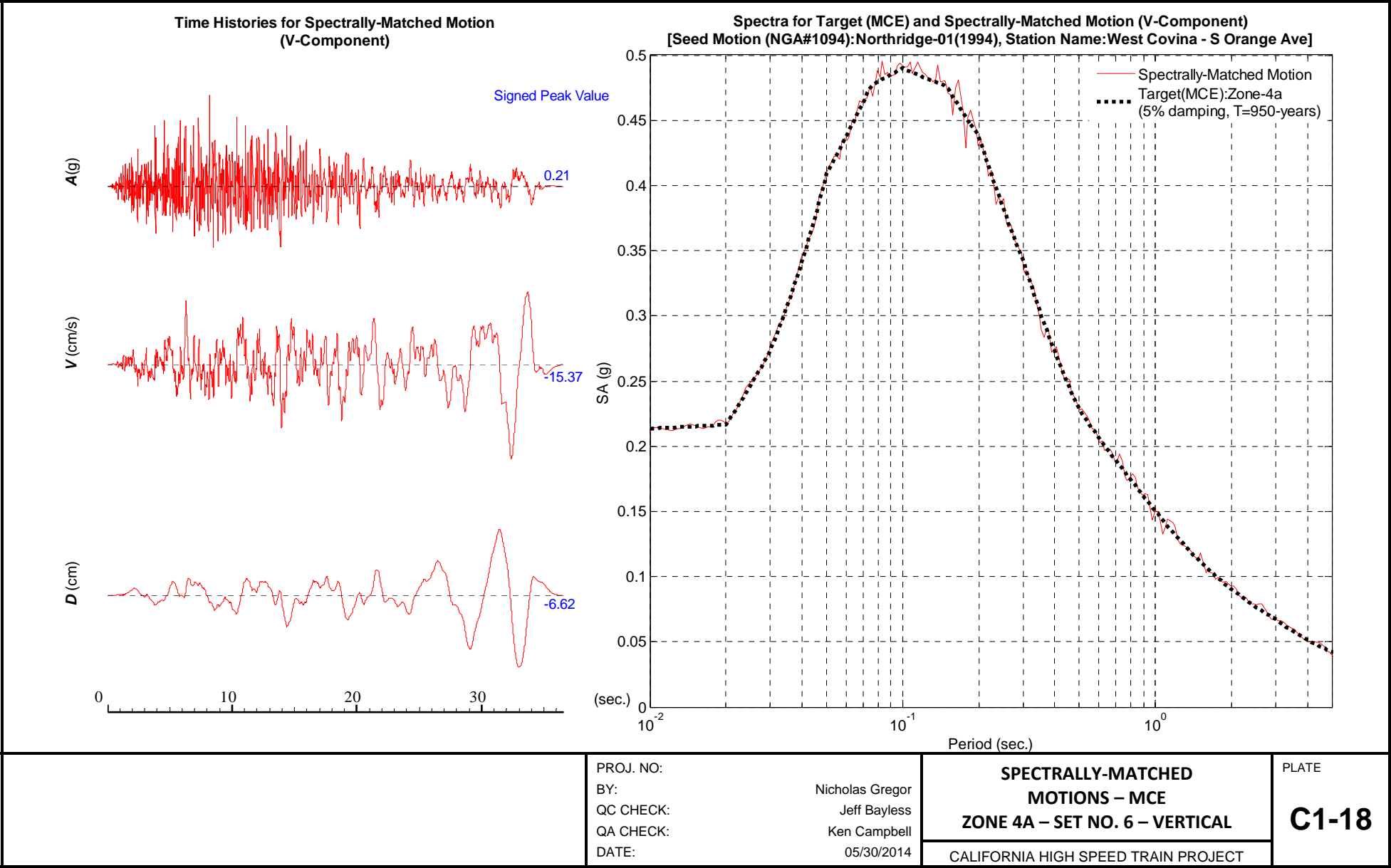


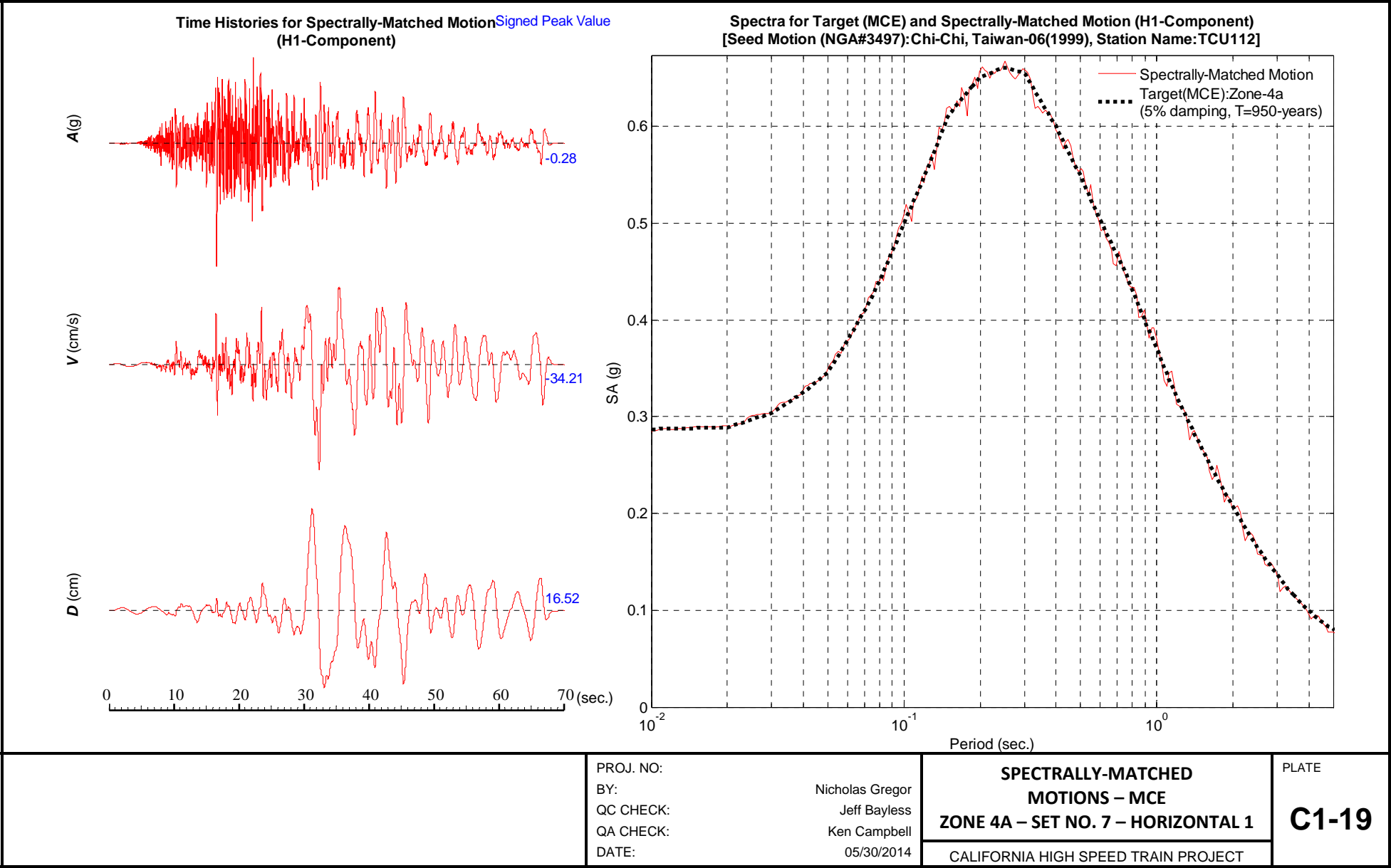


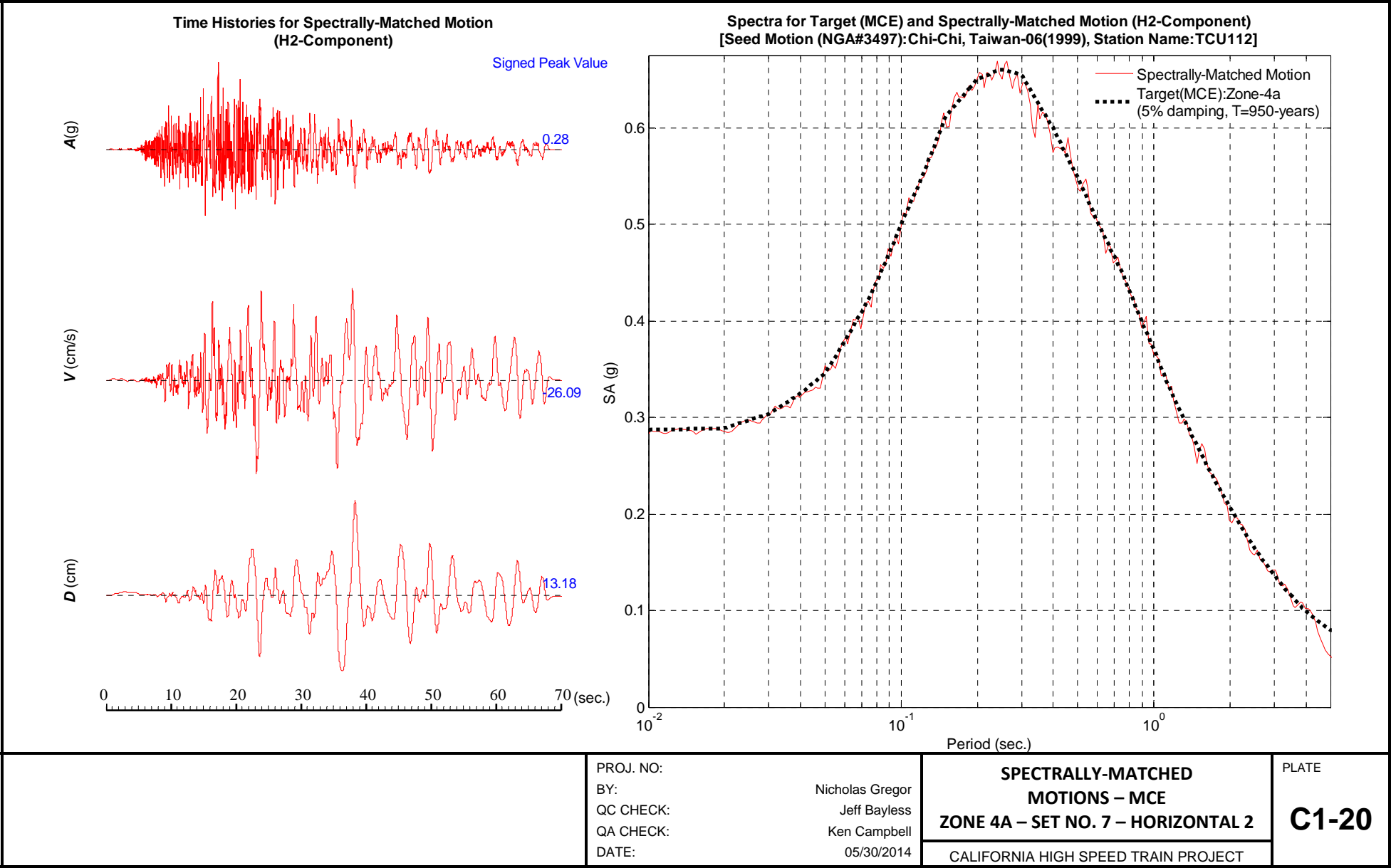




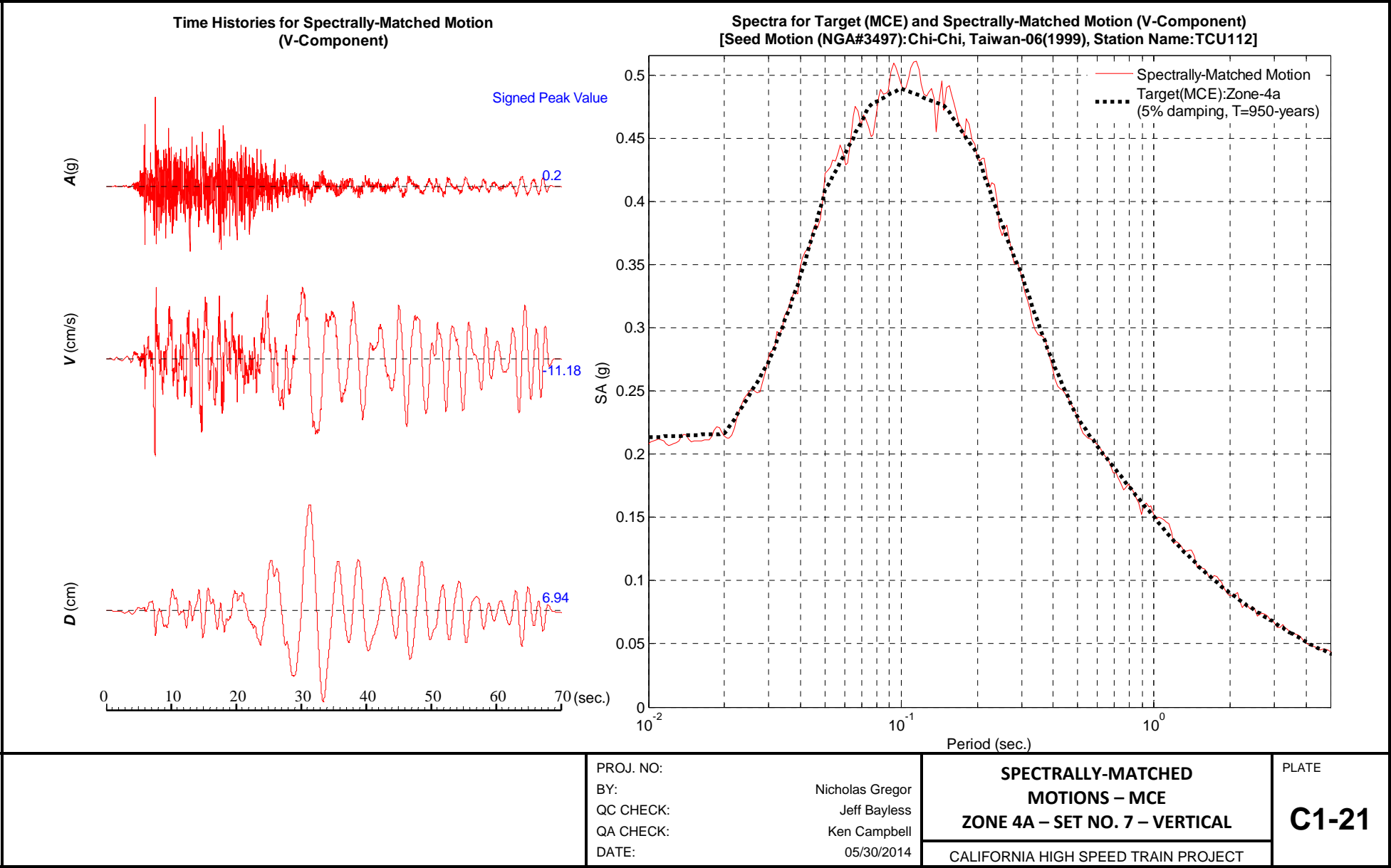












**Table C.3:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for Zone 4b**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.274	32.402	20.346	0.282	34.420	24.095	0.209	21.067	16.305
2	832	Landers	1992	Amboy	7.28	69.21	0.273	37.694	23.874	0.276	36.179	14.445	0.210	18.963	7.486
3	1637	Manjil, Iran	1990	Rudсар	7.37	64.47	0.269	30.462	11.355	0.270	34.341	9.642	0.212	16.909	8.169
4	176	Imperial Valley-06	1979	El Centro Array #13	6.53	21.98	0.285	31.825	21.089	0.277	37.425	14.039	0.209	16.642	7.408
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.271	34.412	16.613	0.287	39.510	18.823	0.215	19.594	9.596
6	28	Parkfield	1966	Cholame - Shandon Array #12	6.19	17.64	0.278	30.152	18.536	0.278	33.940	17.123	0.205	13.466	7.223
7	1776	Hector Mine	1999	Desert Hot Springs	7.13	56.40	0.279	32.570	17.817	0.279	31.625	18.136	0.213	15.929	10.553

PROJ. NO:

BY:

QC CHECK:

QA CHECK:

DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

05/30/2014

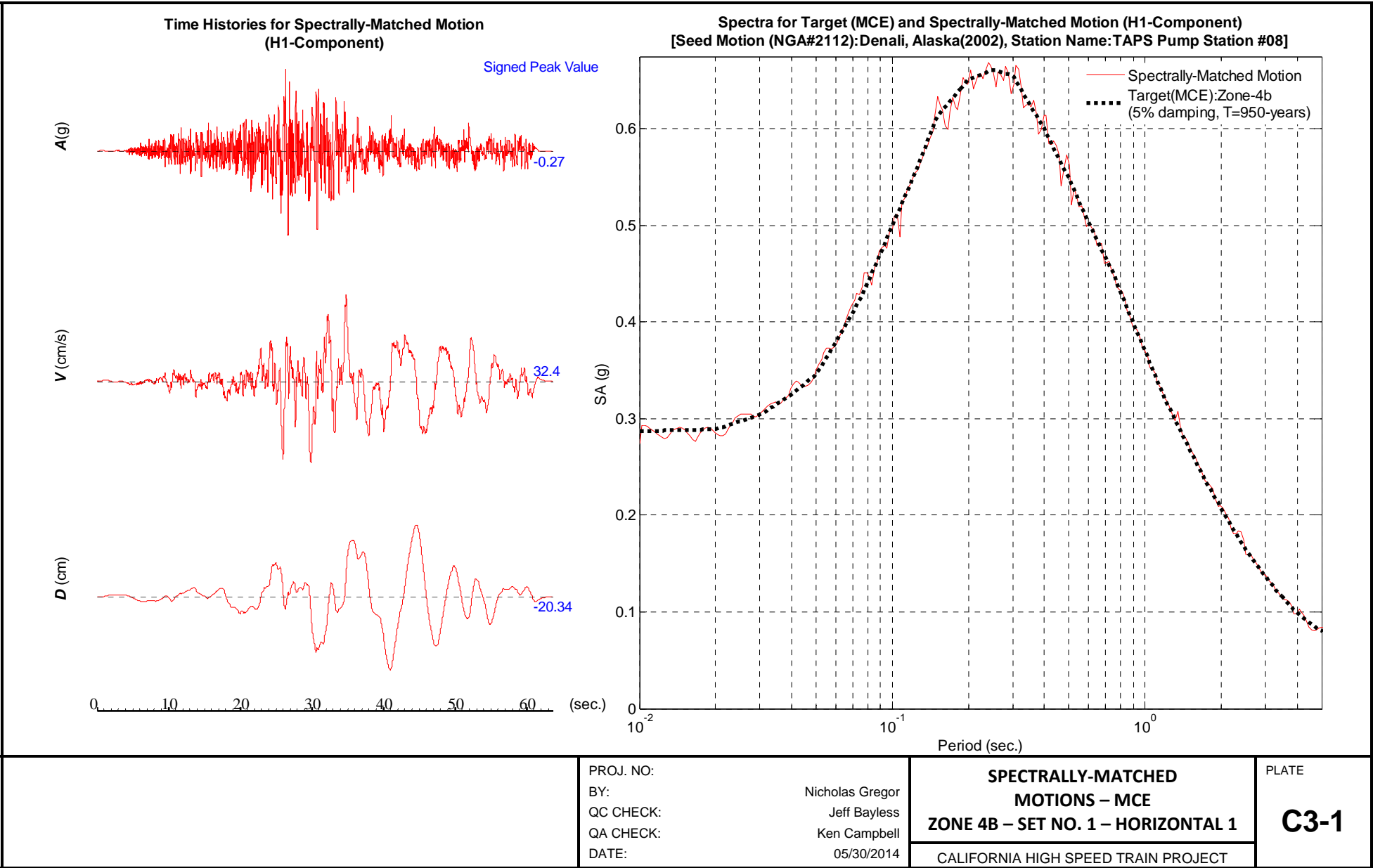
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
MCE – ZONE 4B**

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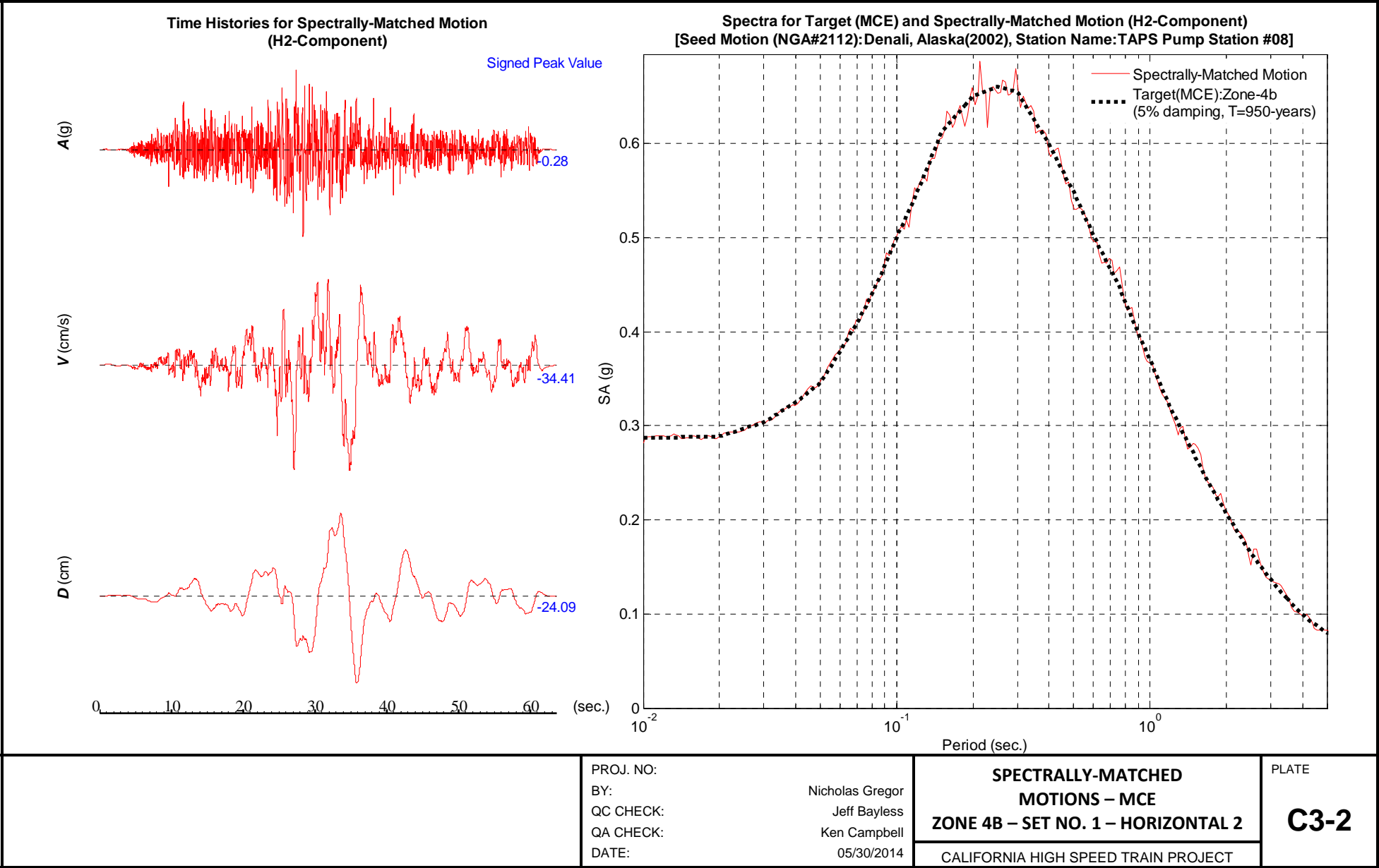
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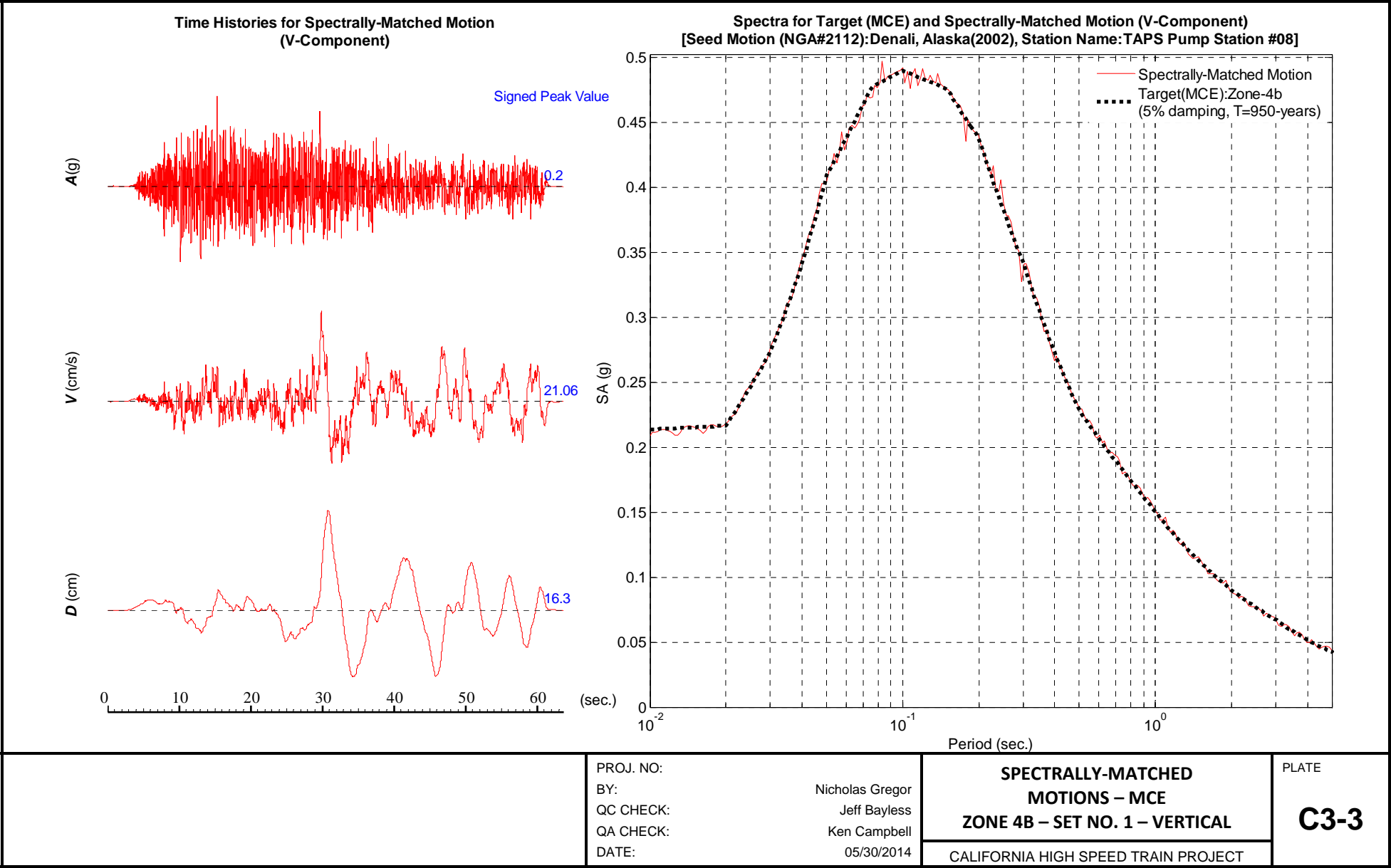
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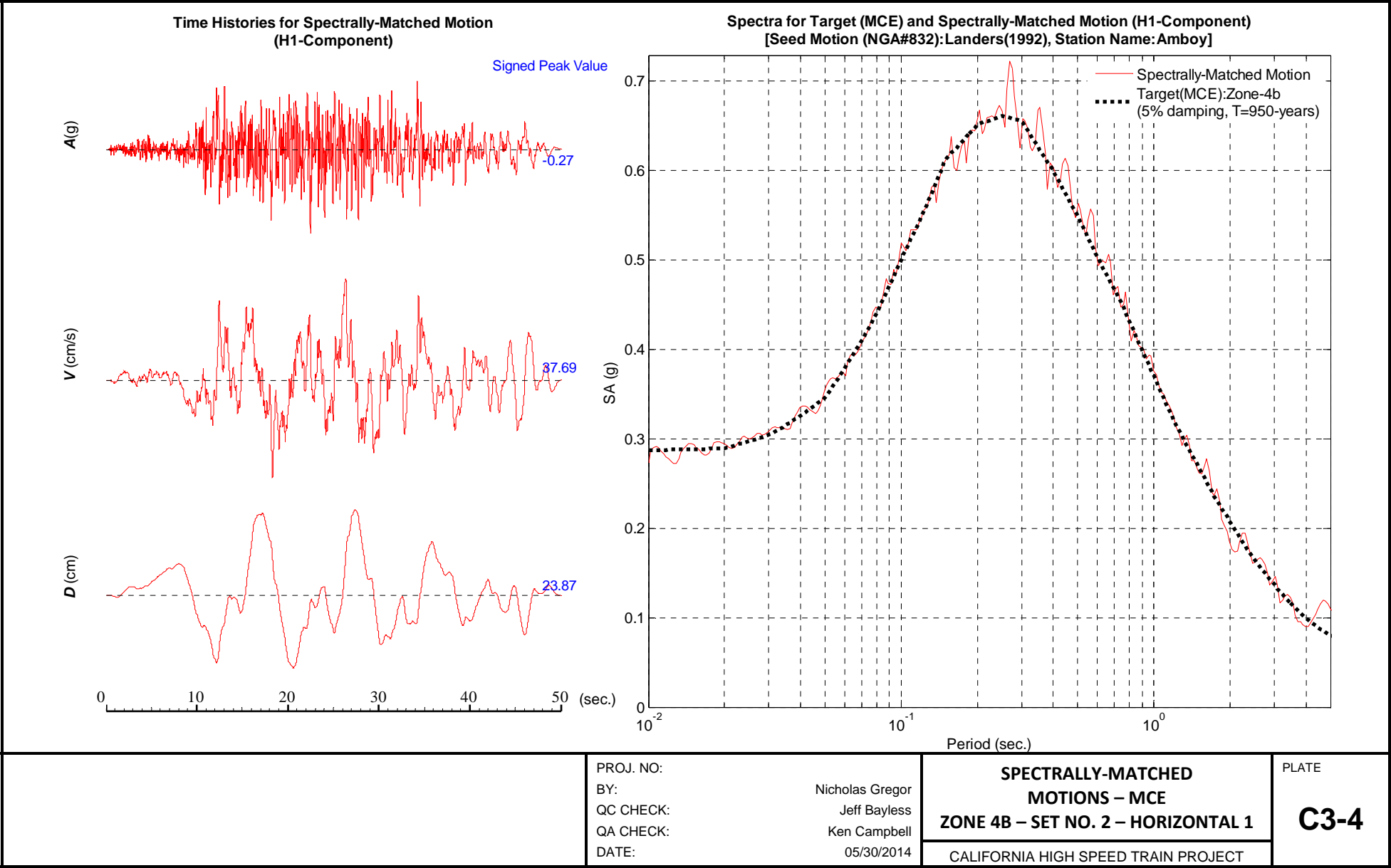
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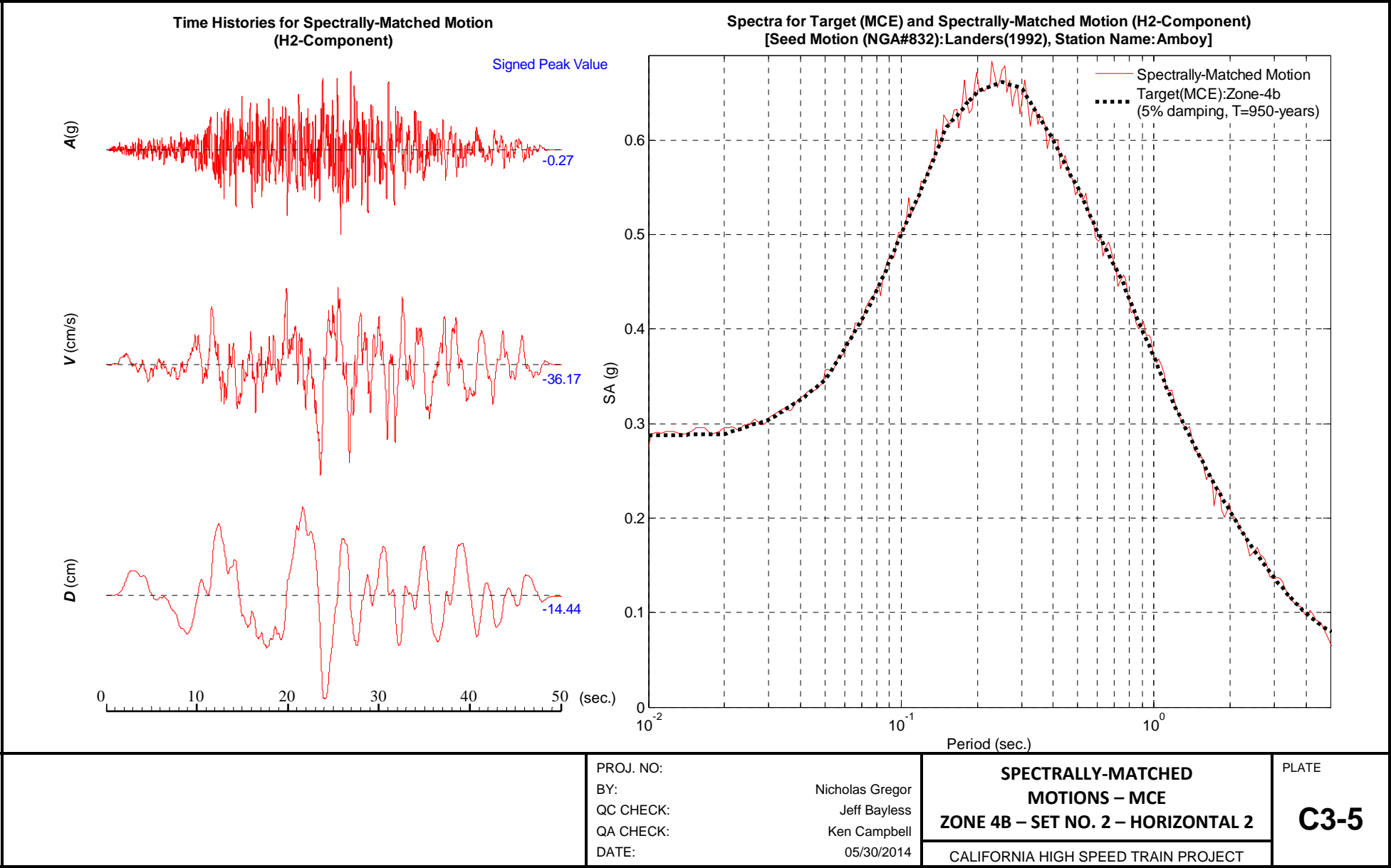


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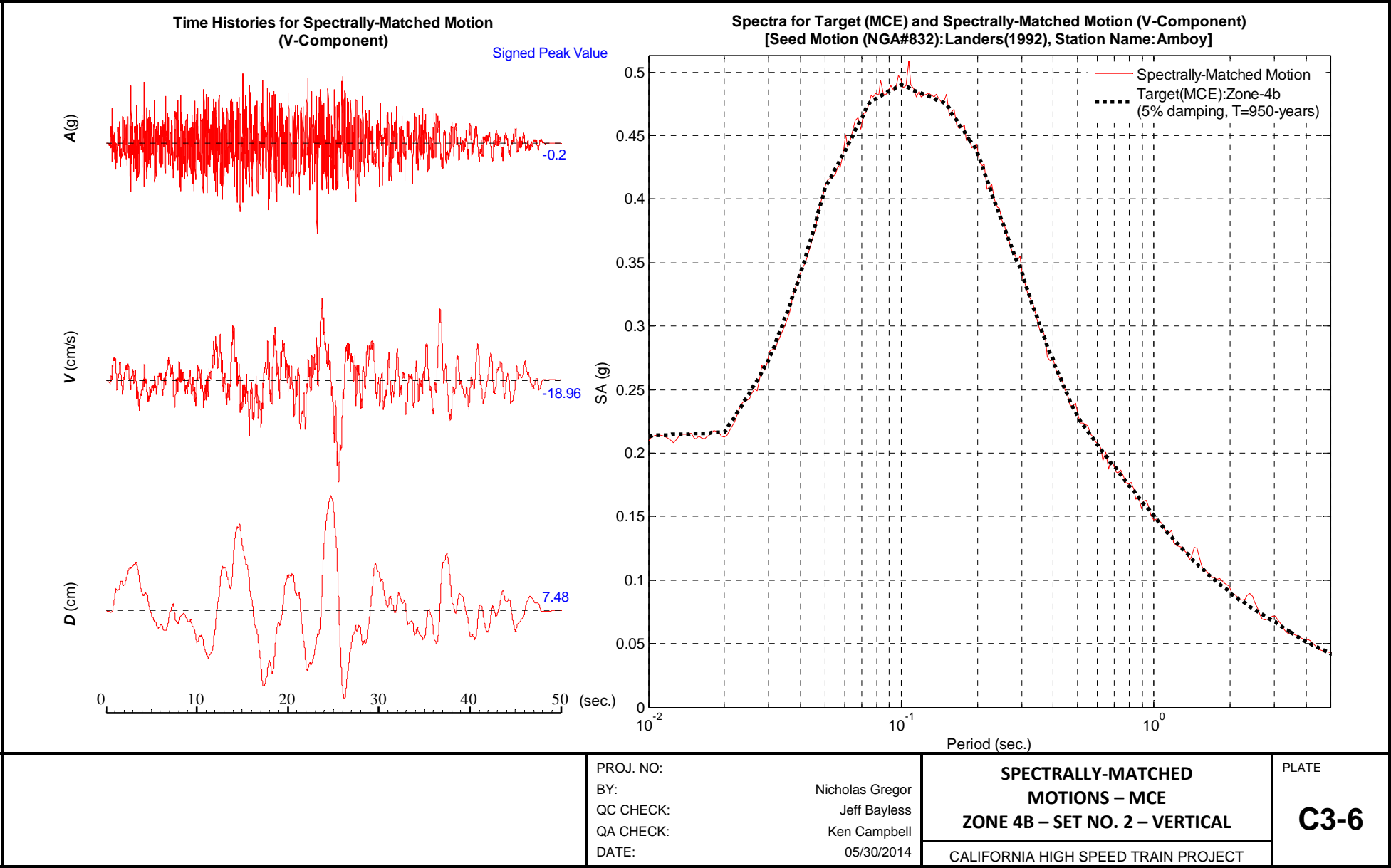


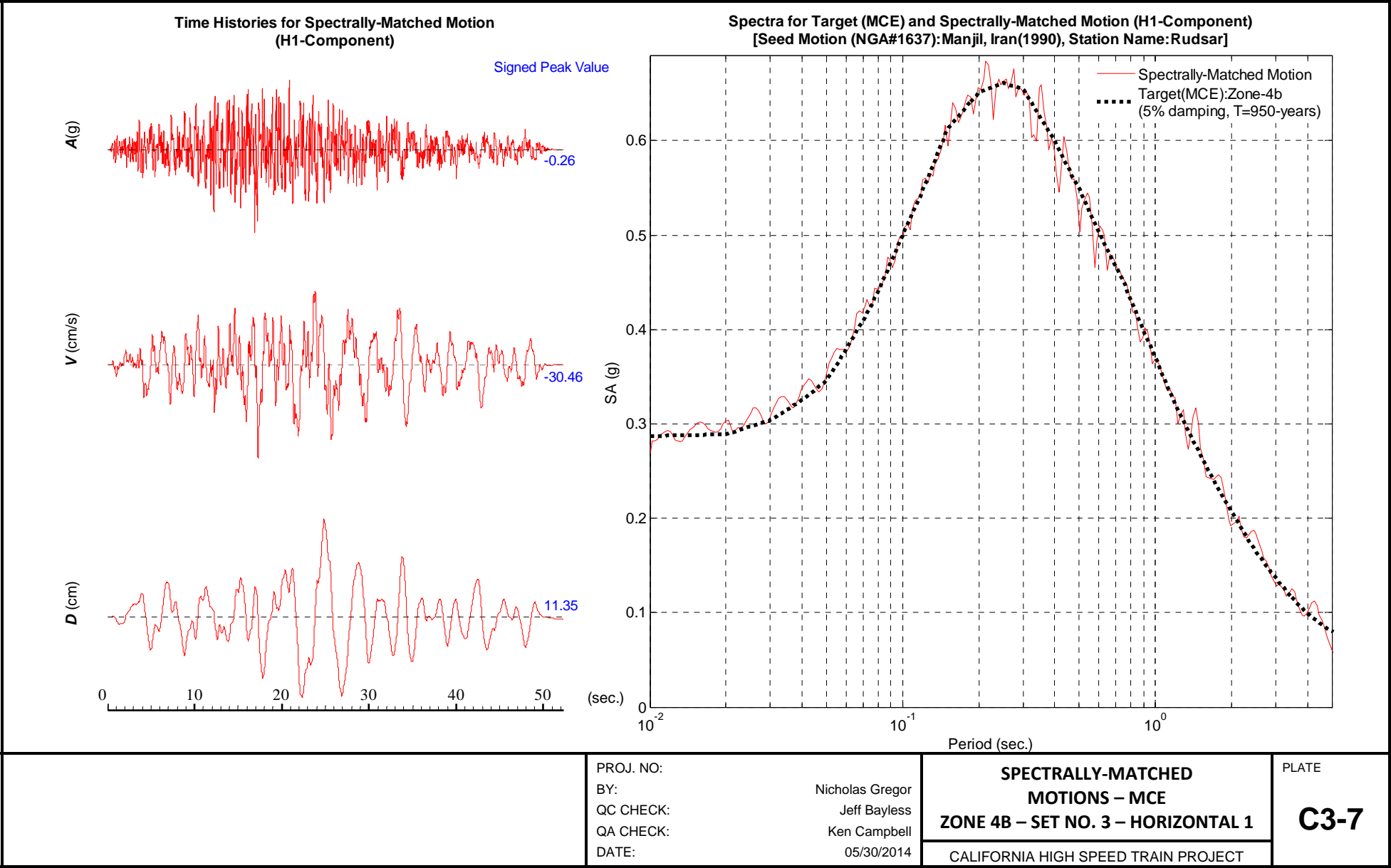


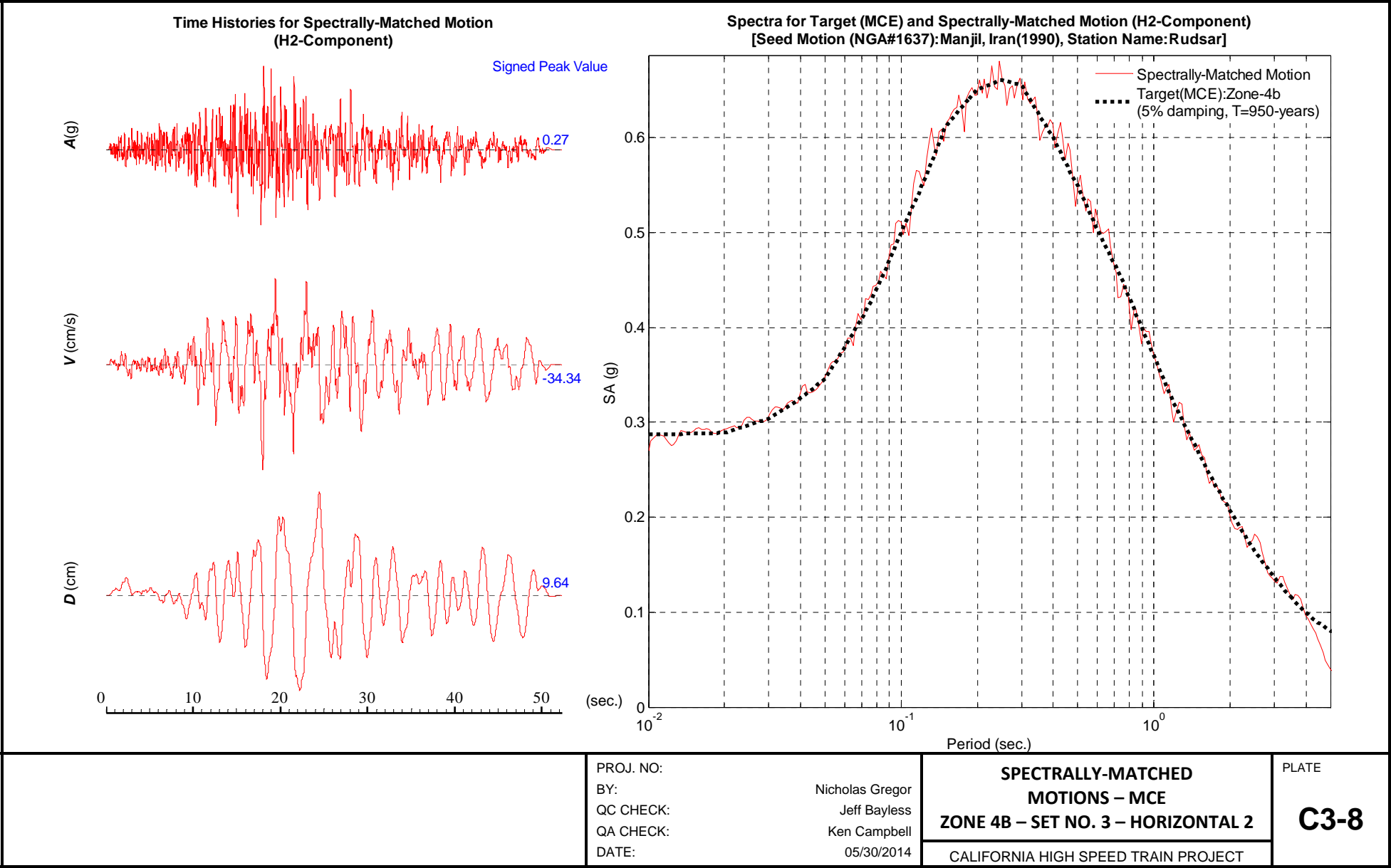


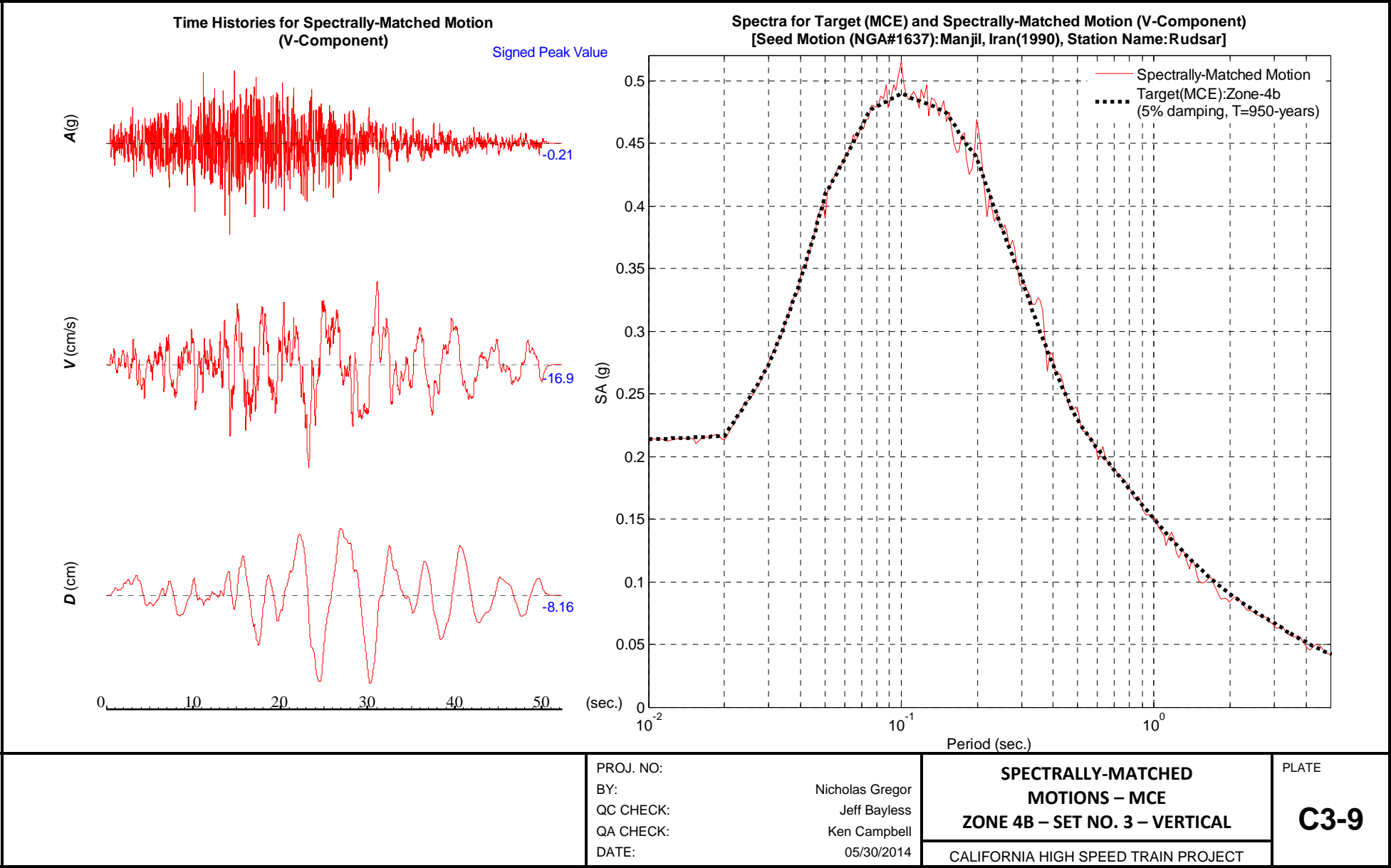


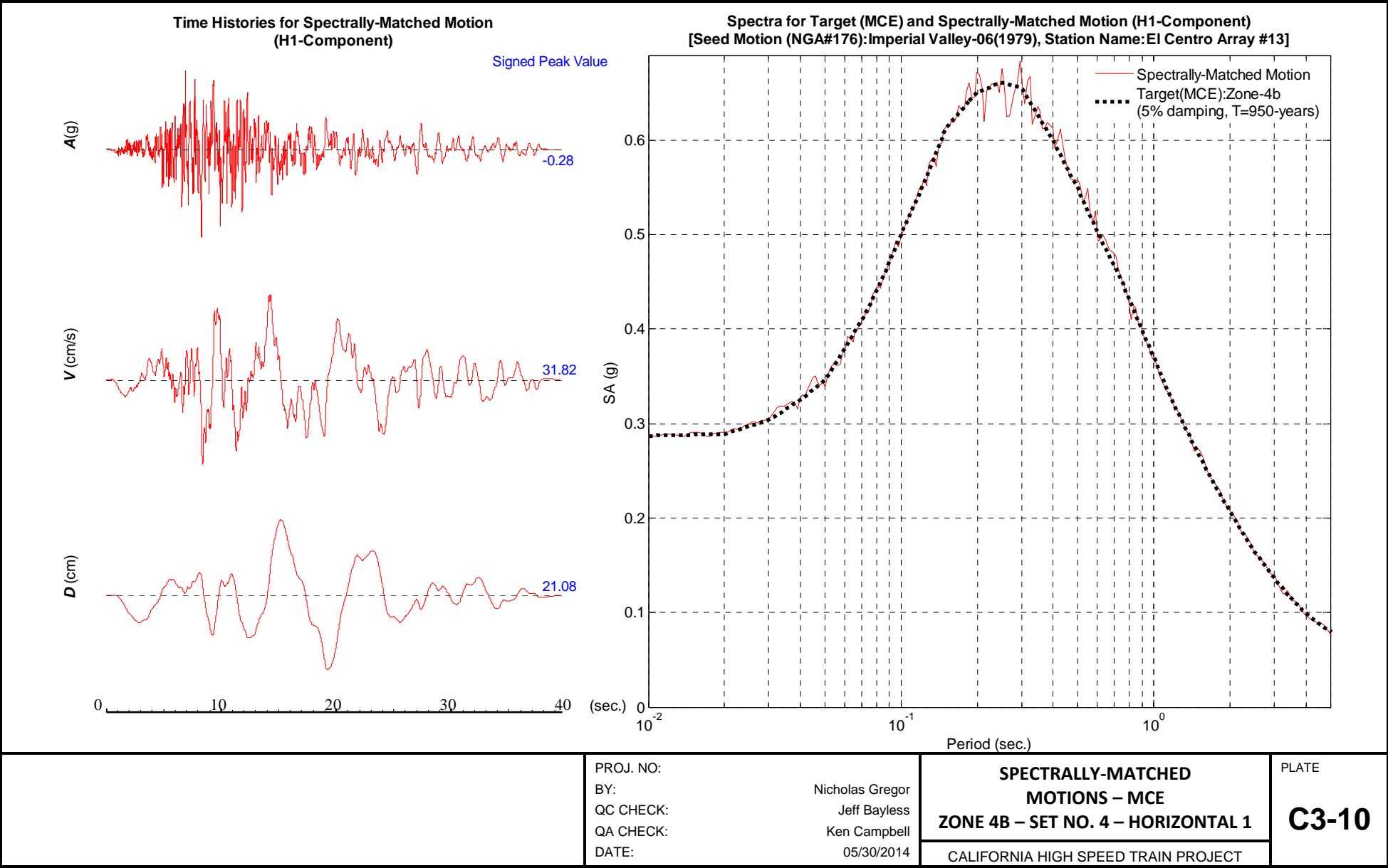


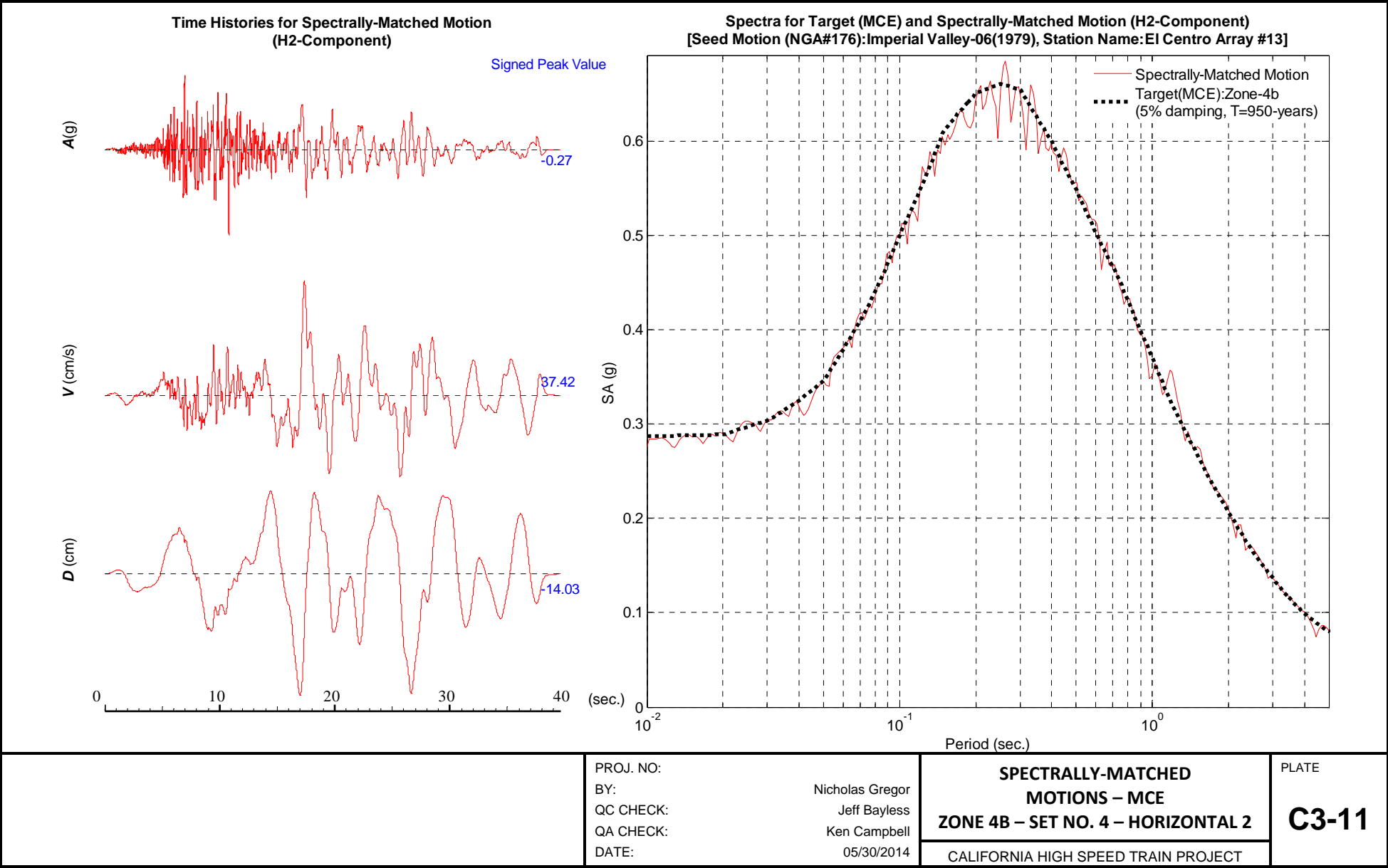


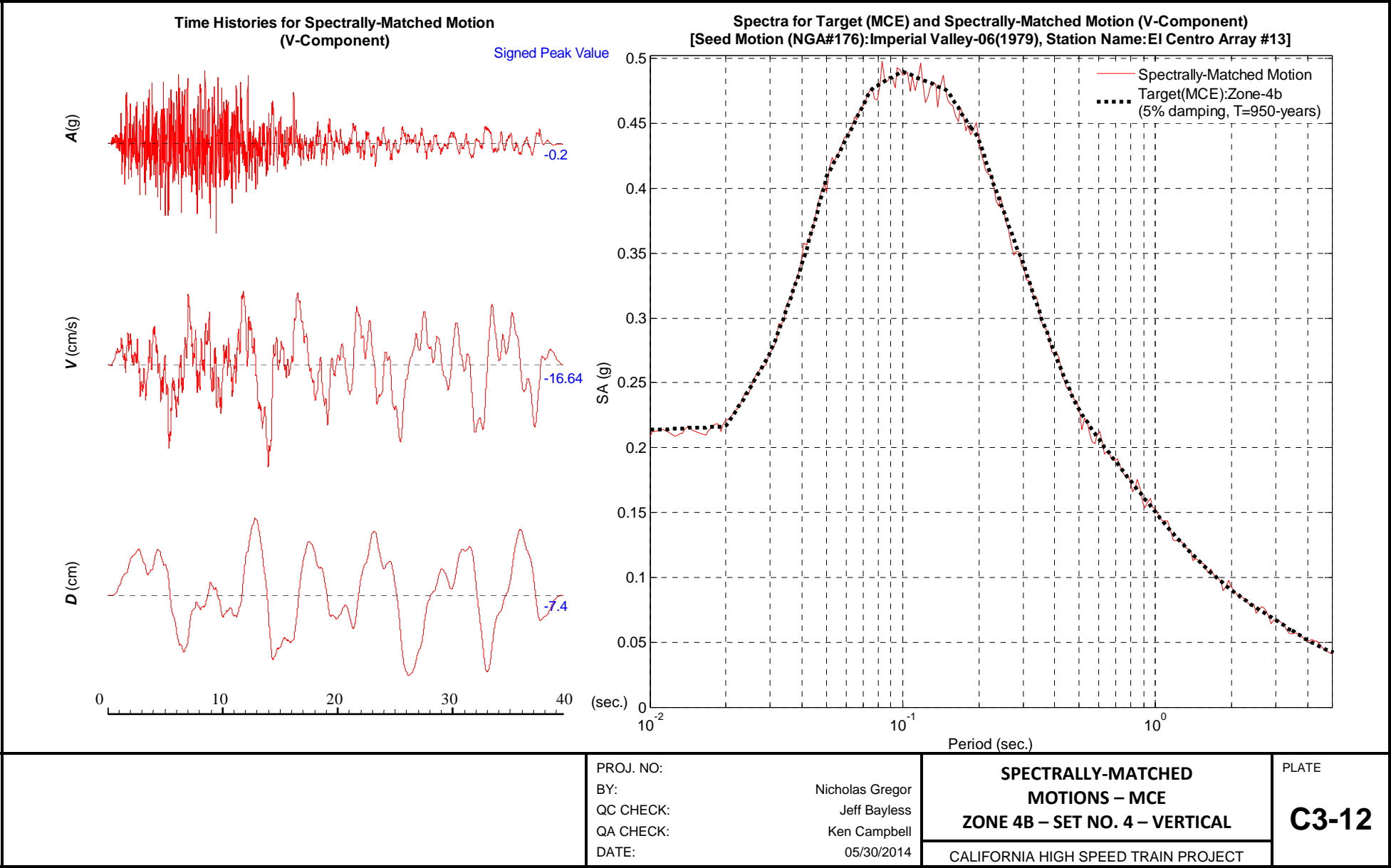




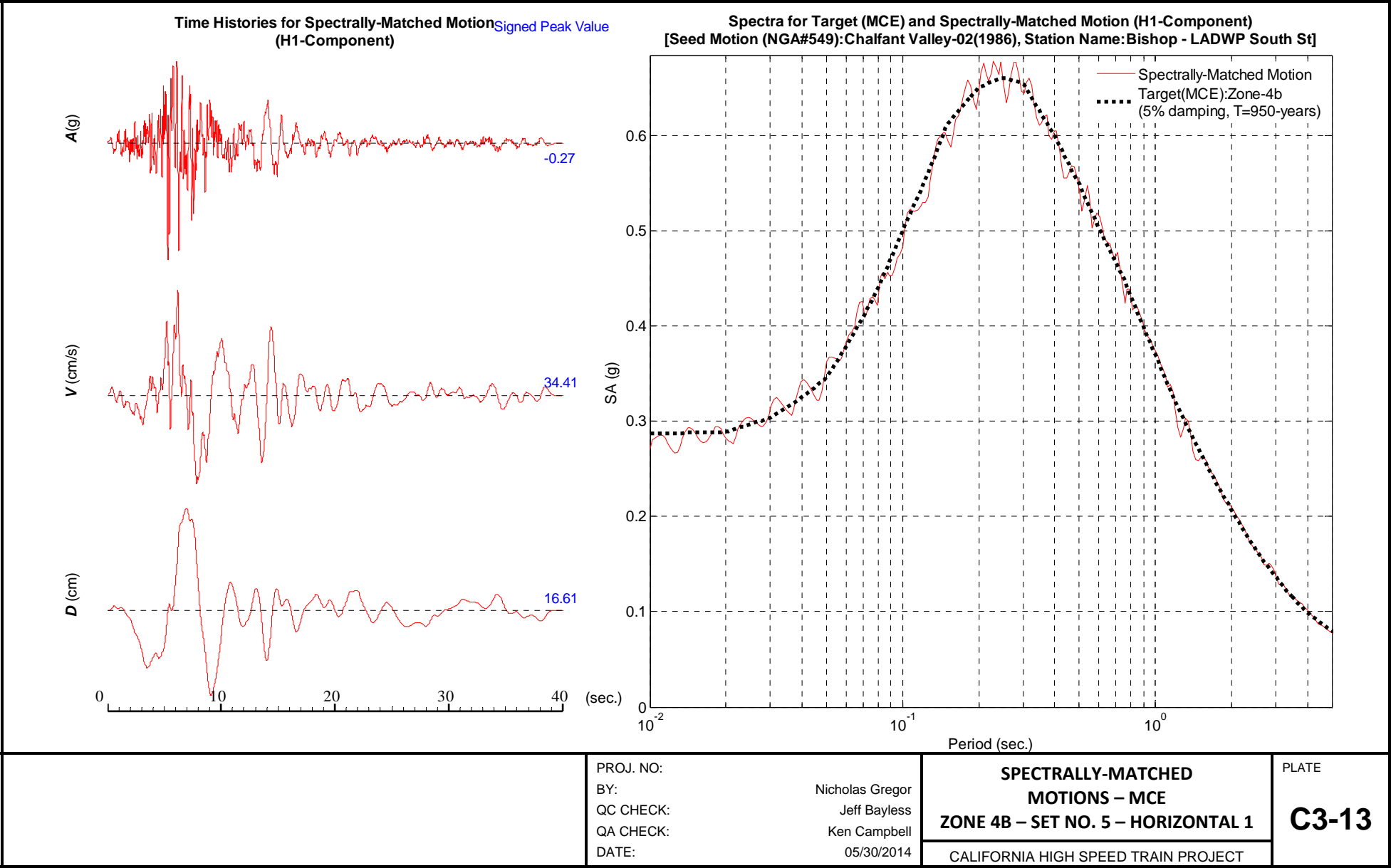




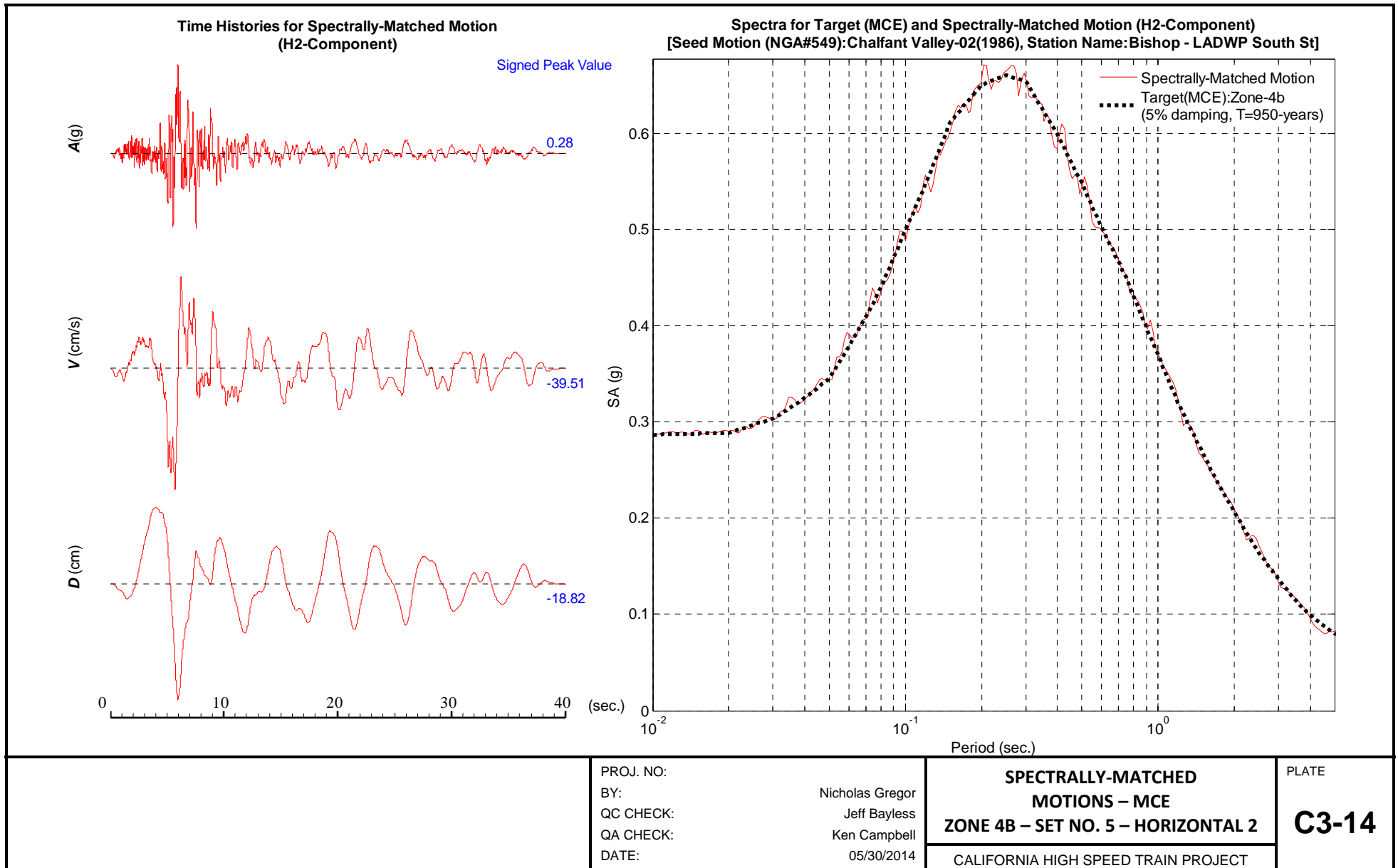


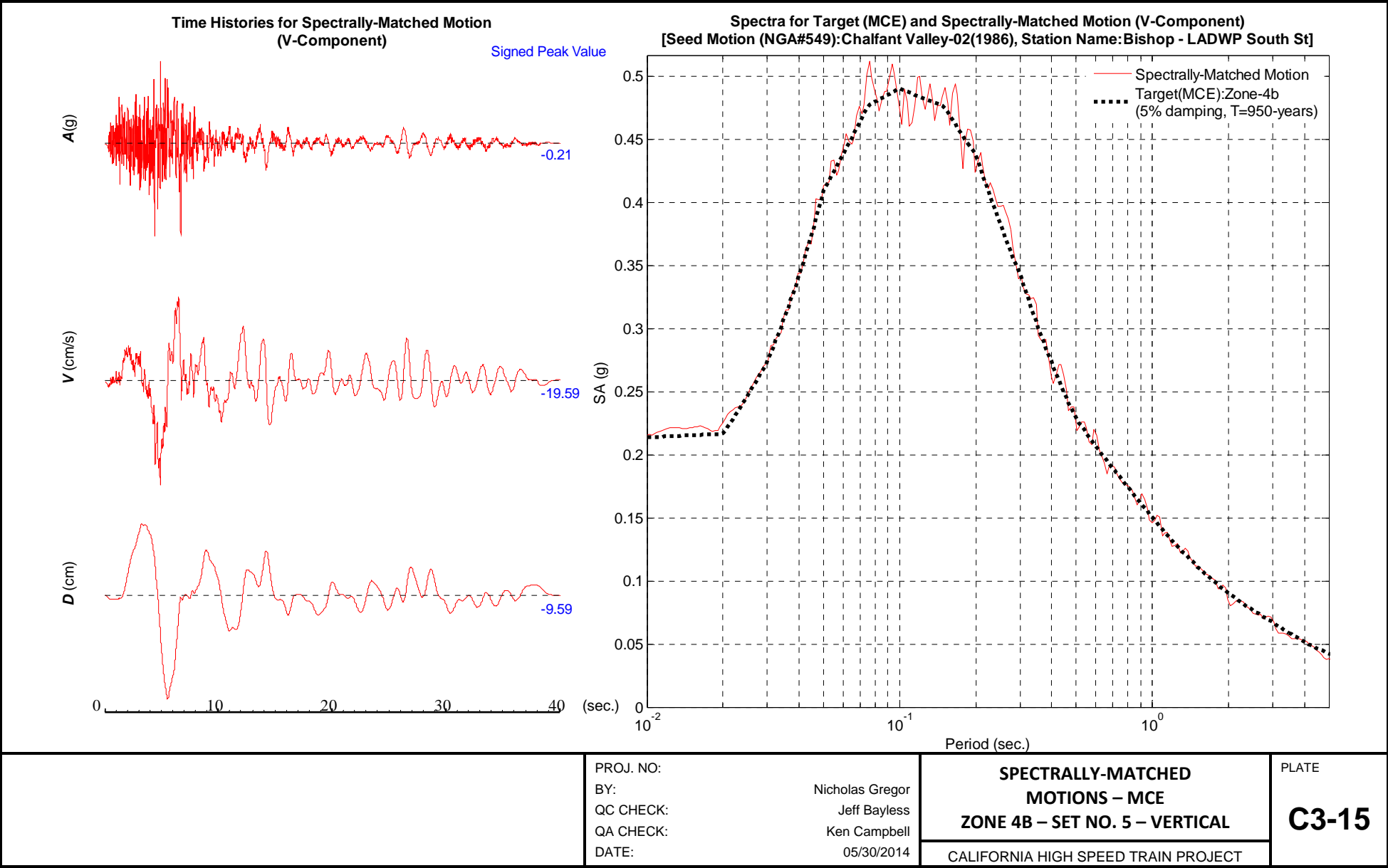


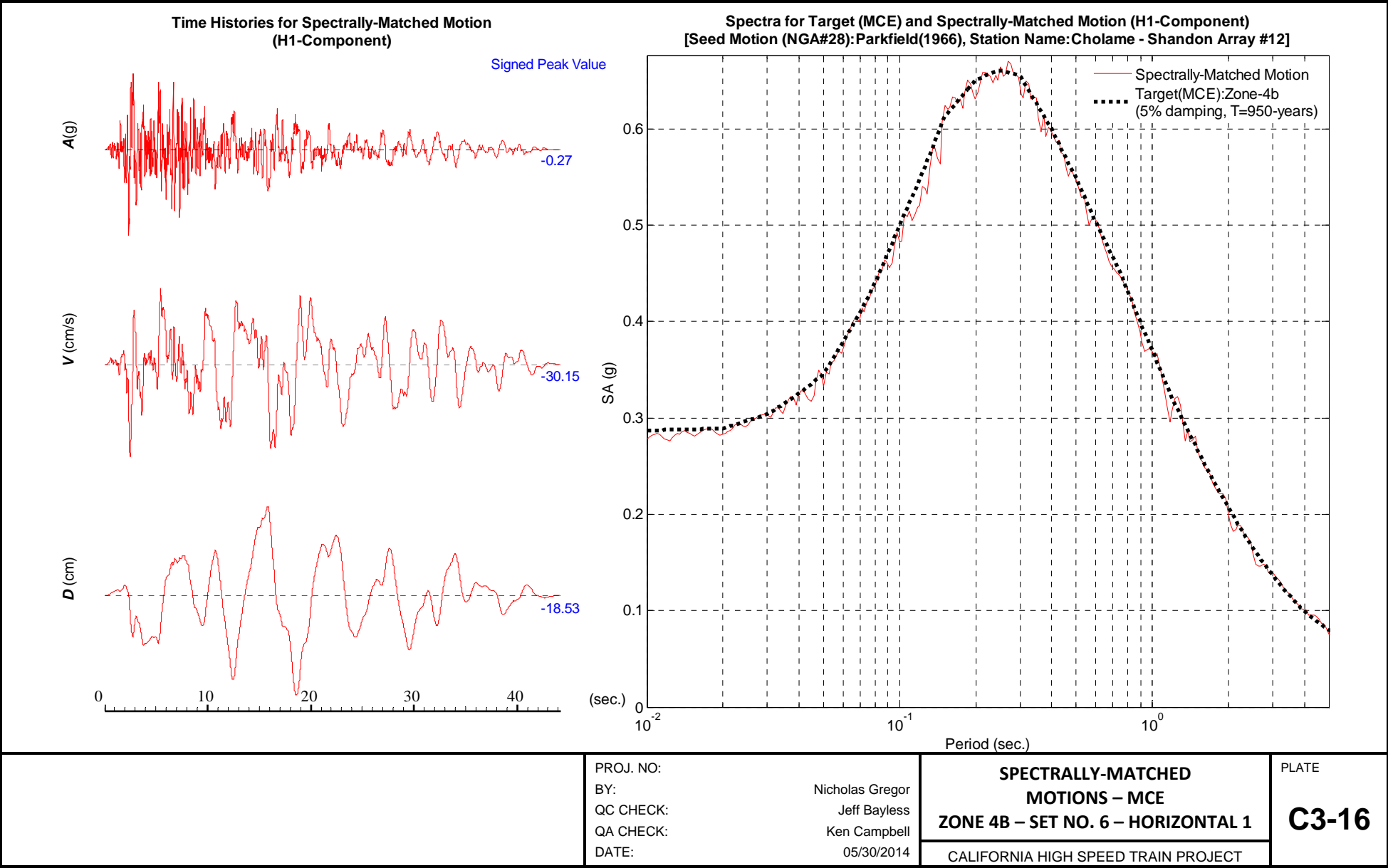
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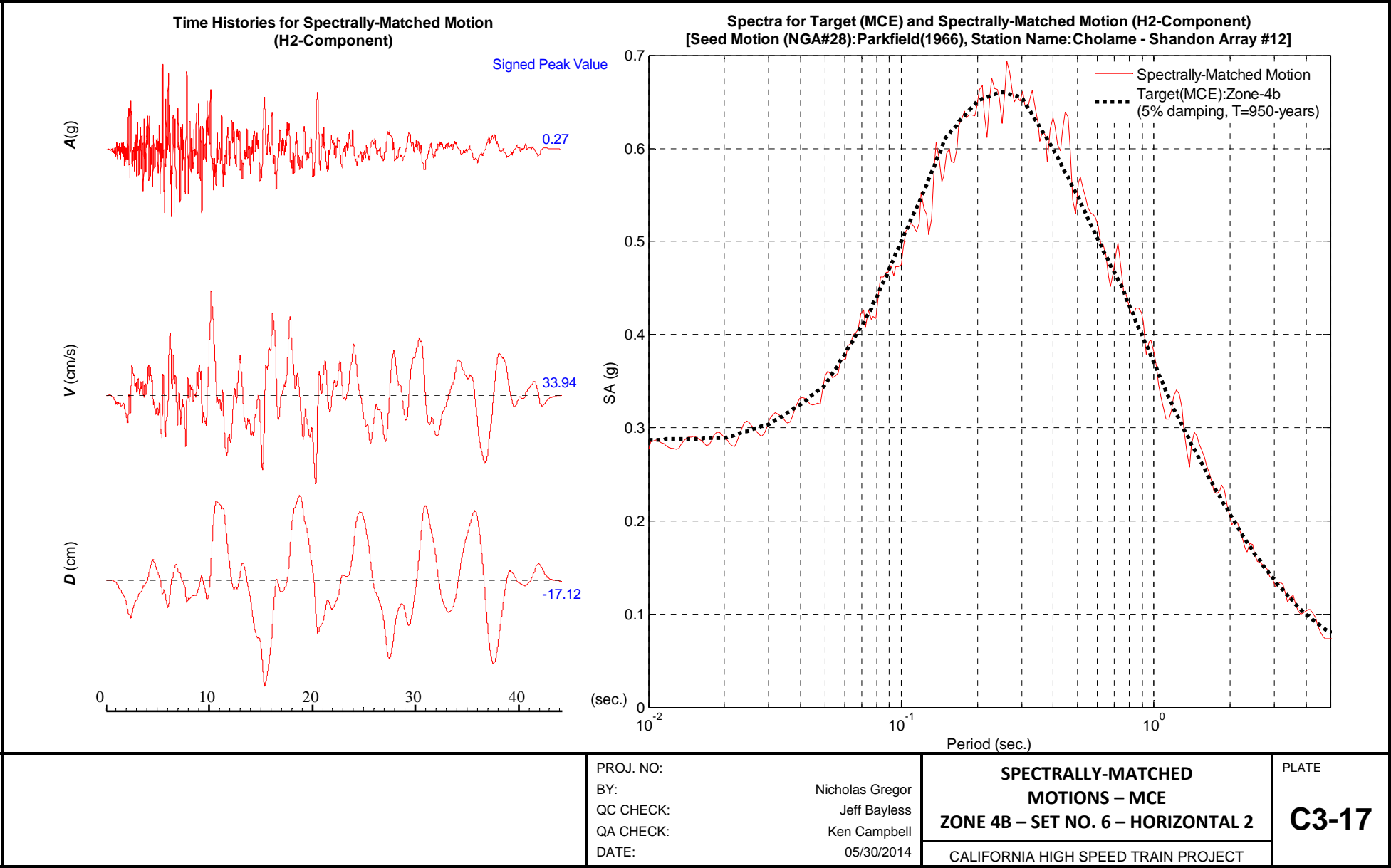


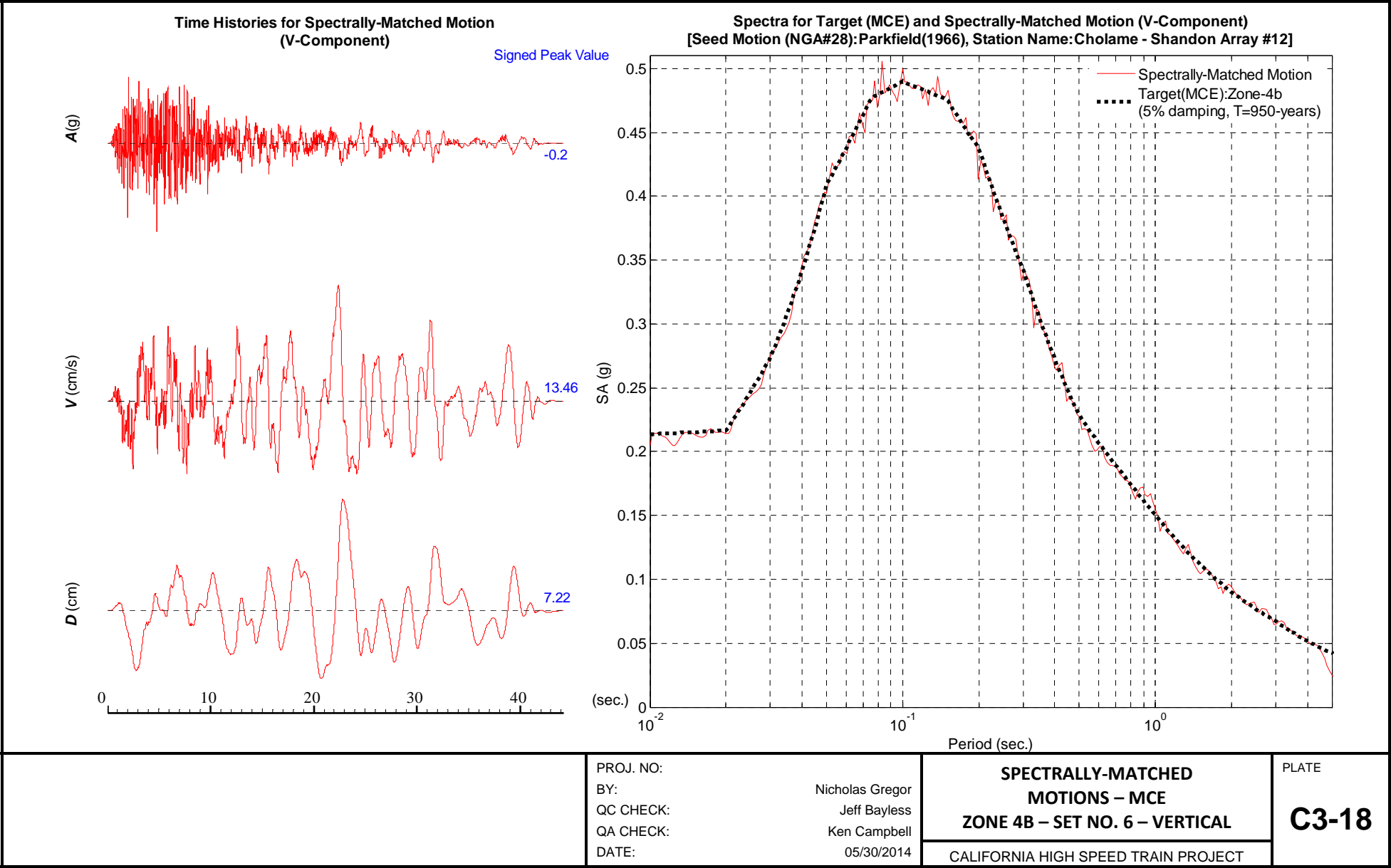




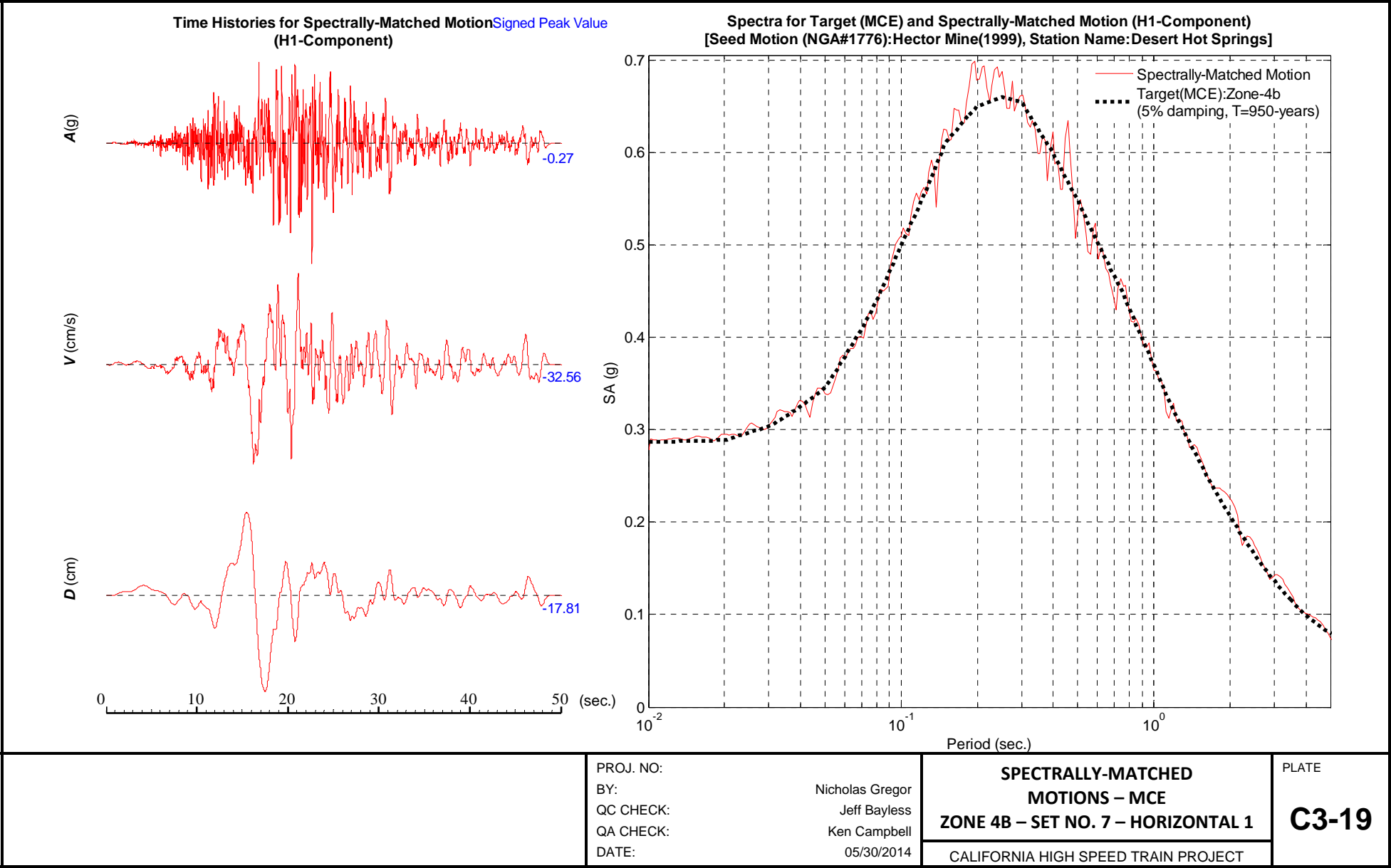


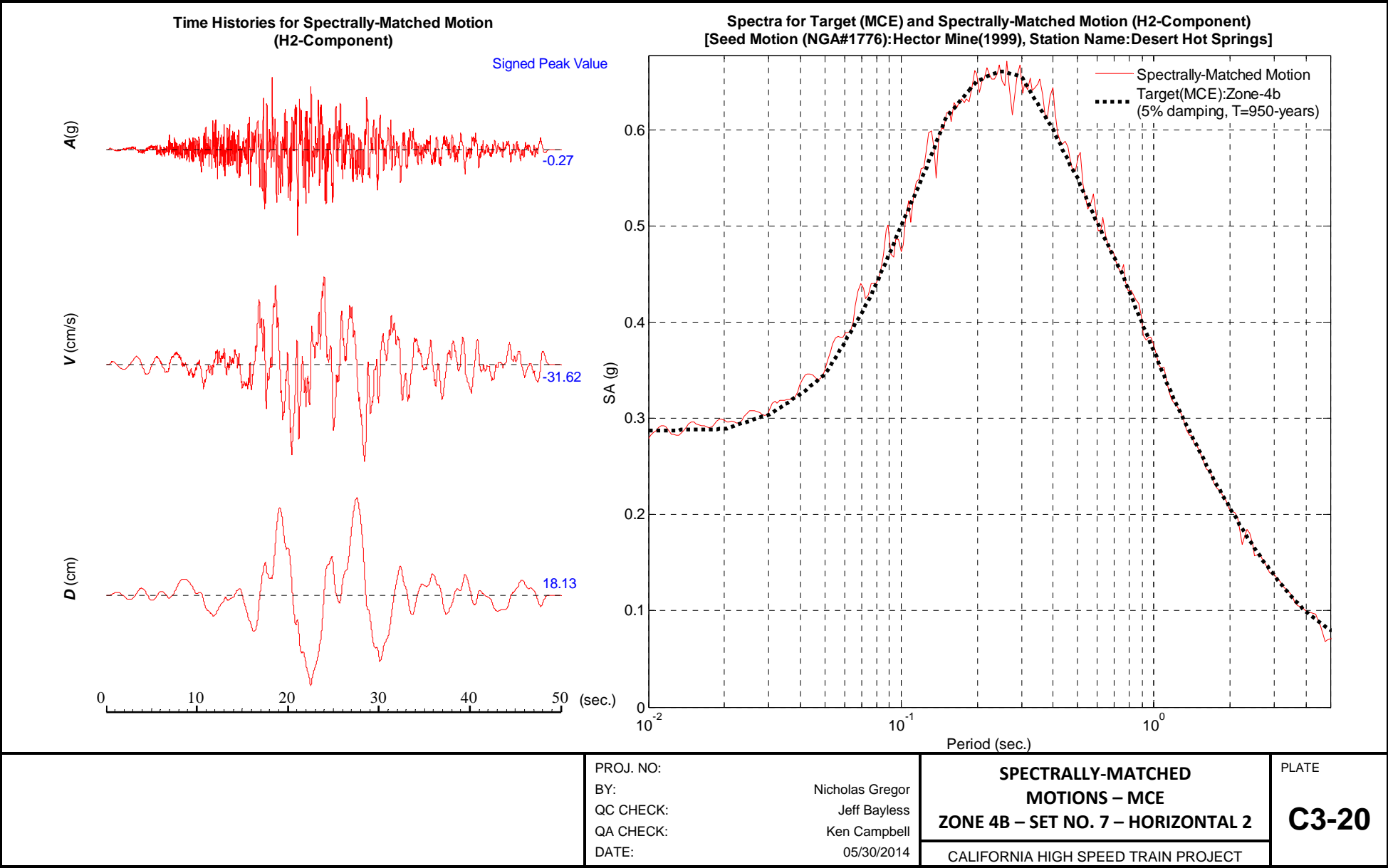


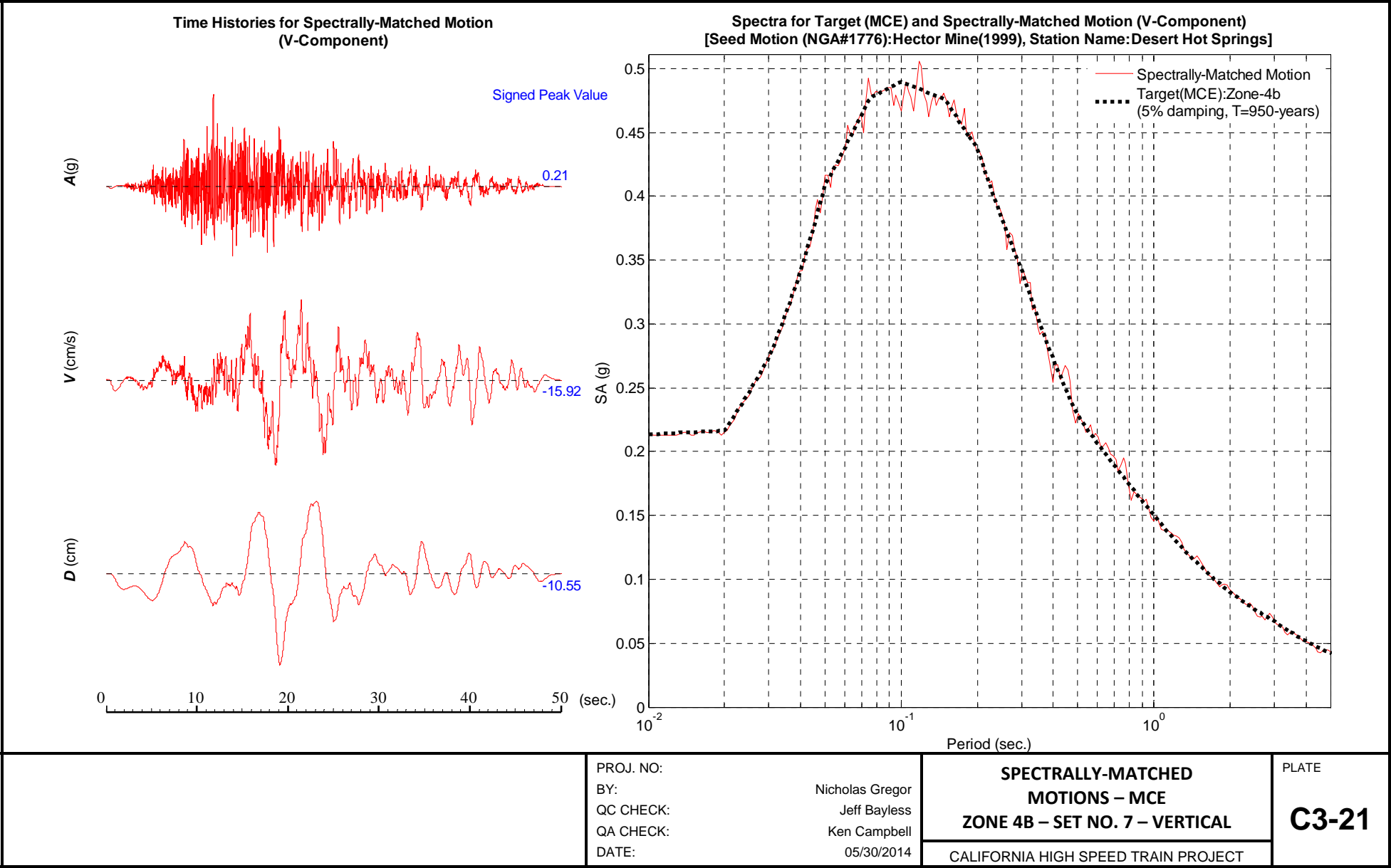




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**Table A.6:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for Zone 3**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA	PGV	PGD	PGA	PGV	PGD	PGA	PGV	PGD
							H1 (g)	H1 (cm/s)	H1 (cm)	H2 (g)	H2 (cm/s)	H2 (cm)	V (g)	V (cm/s)	V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.072	6.566	3.895	0.072	7.264	3.969	0.060	3.915	3.033
2	2776	Chi-Chi, Taiwan-04	1999	HWA028	6.20	92.39	0.075	7.668	2.394	0.071	5.875	1.853	0.059	2.098	0.944
3	933	Big Bear-01	1992	Seal Beach - Office Bldg	6.46	126.22	0.077	8.142	2.866	0.072	7.154	2.598	0.058	2.455	1.170
4	1809	Hector Mine	1999	Lytle Creek Fire Station	7.13	112.26	0.075	7.026	3.687	0.076	6.305	4.771	0.058	4.105	1.827
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.070	7.674	3.233	0.074	8.771	4.212	0.060	4.038	1.653
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.071	5.329	2.167	0.072	6.112	2.392	0.059	2.930	1.128
7	3497	Chi-Chi, Taiwan-06	1999	TCU112	6.30	51.72	0.075	6.822	2.831	0.075	5.520	2.510	0.058	2.849	1.353

PROJ. NO:

BY:

QC CHECK:

QA CHECK:

DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

05/22/2014

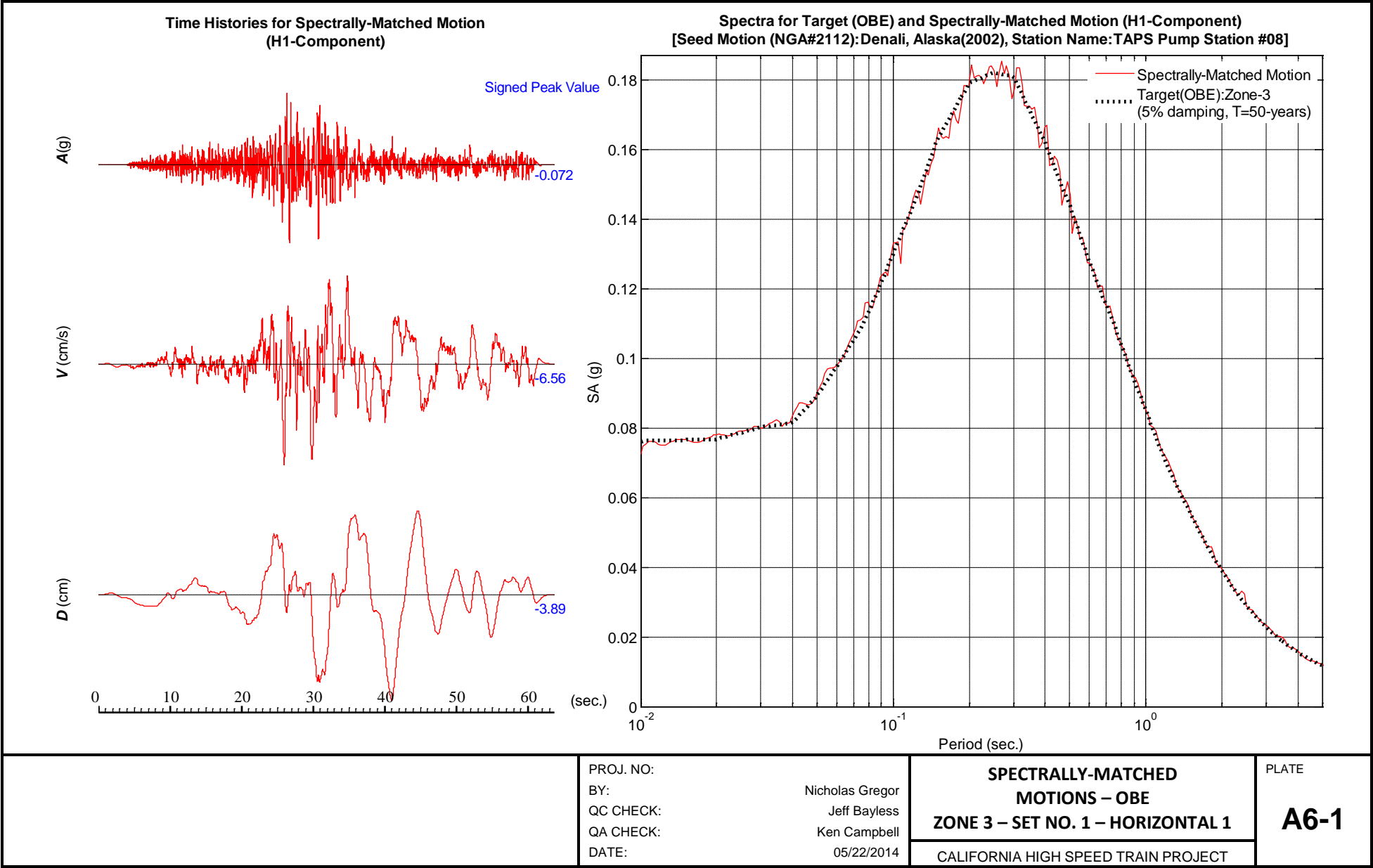
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OBE – ZONE 3**

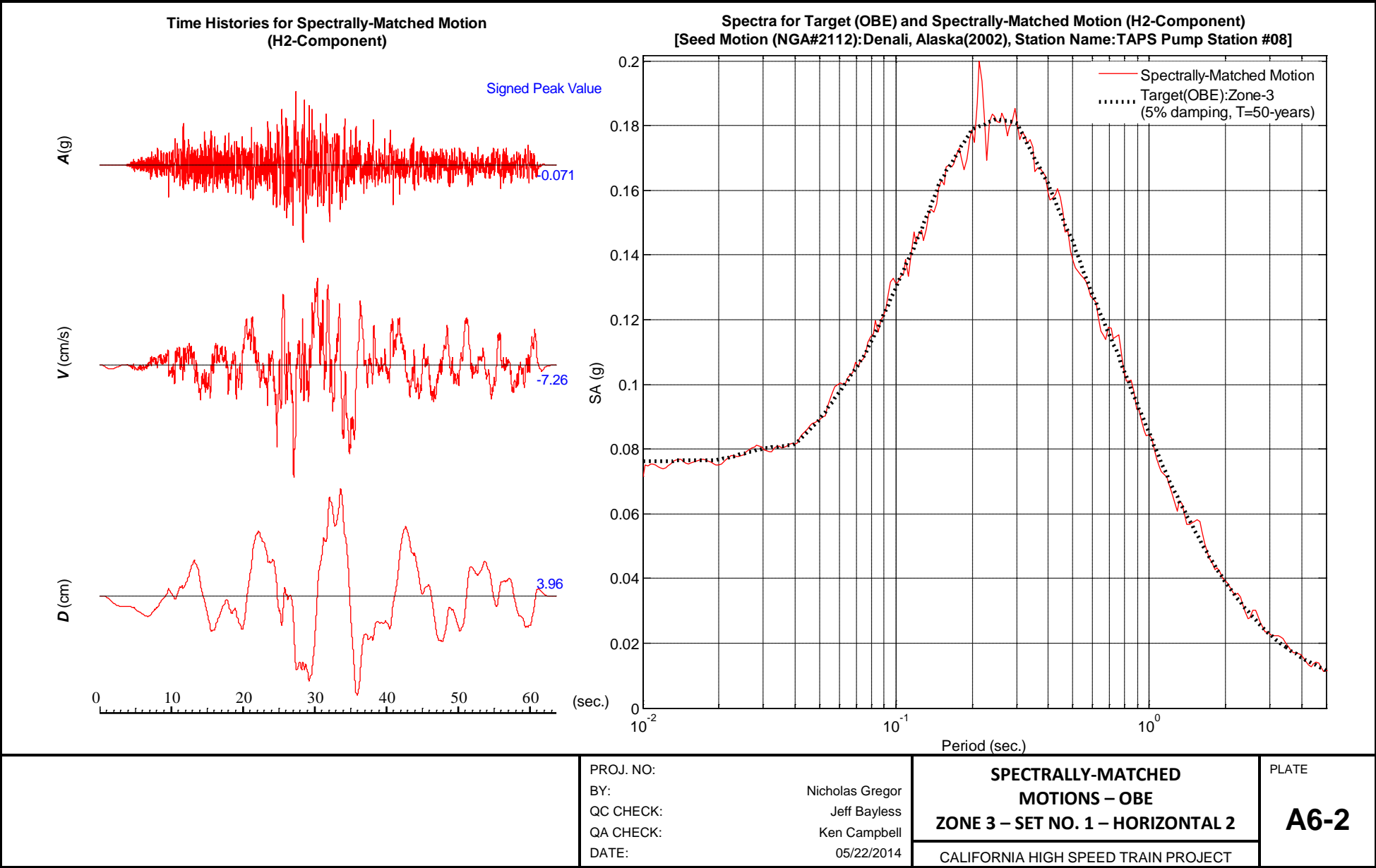
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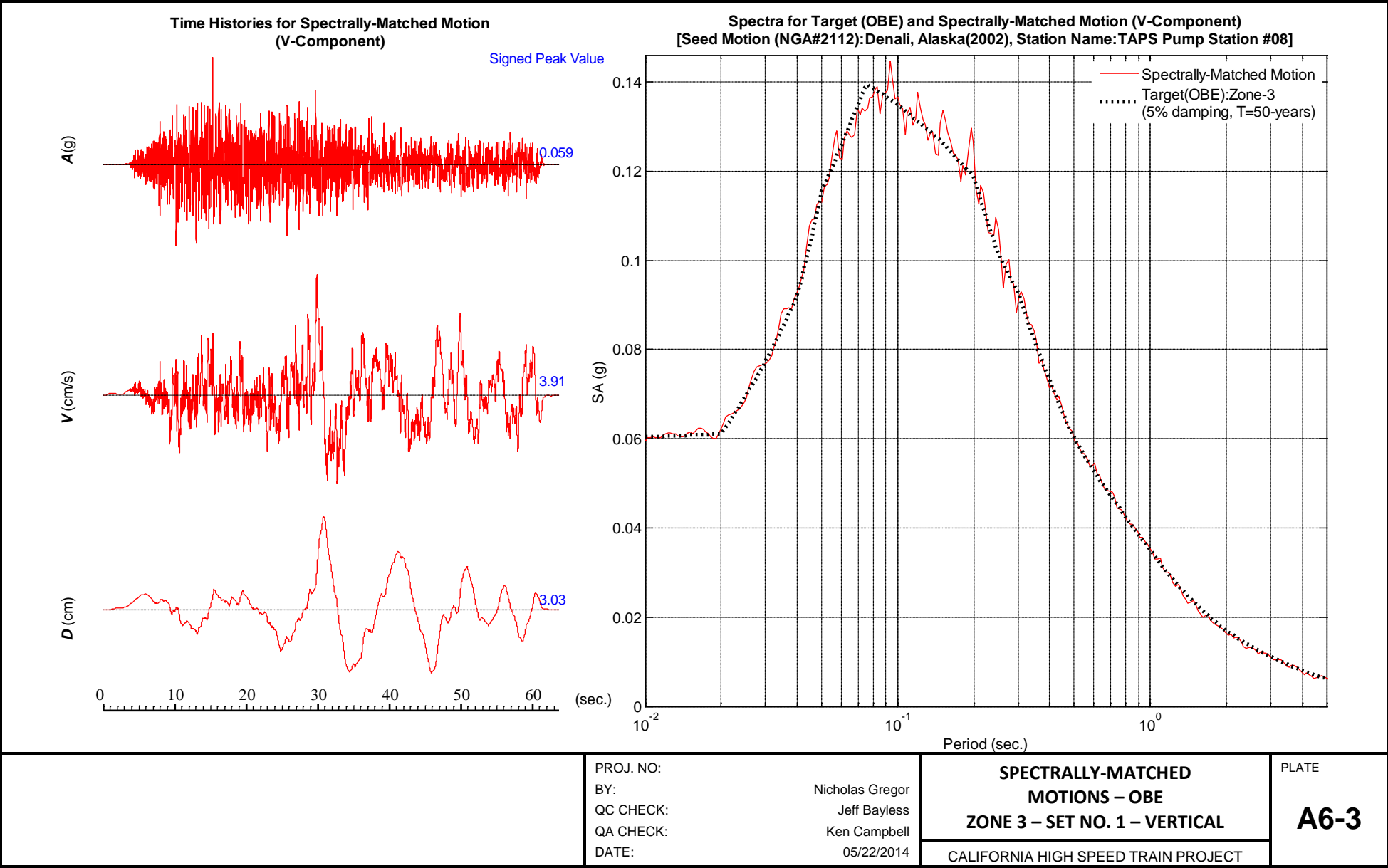
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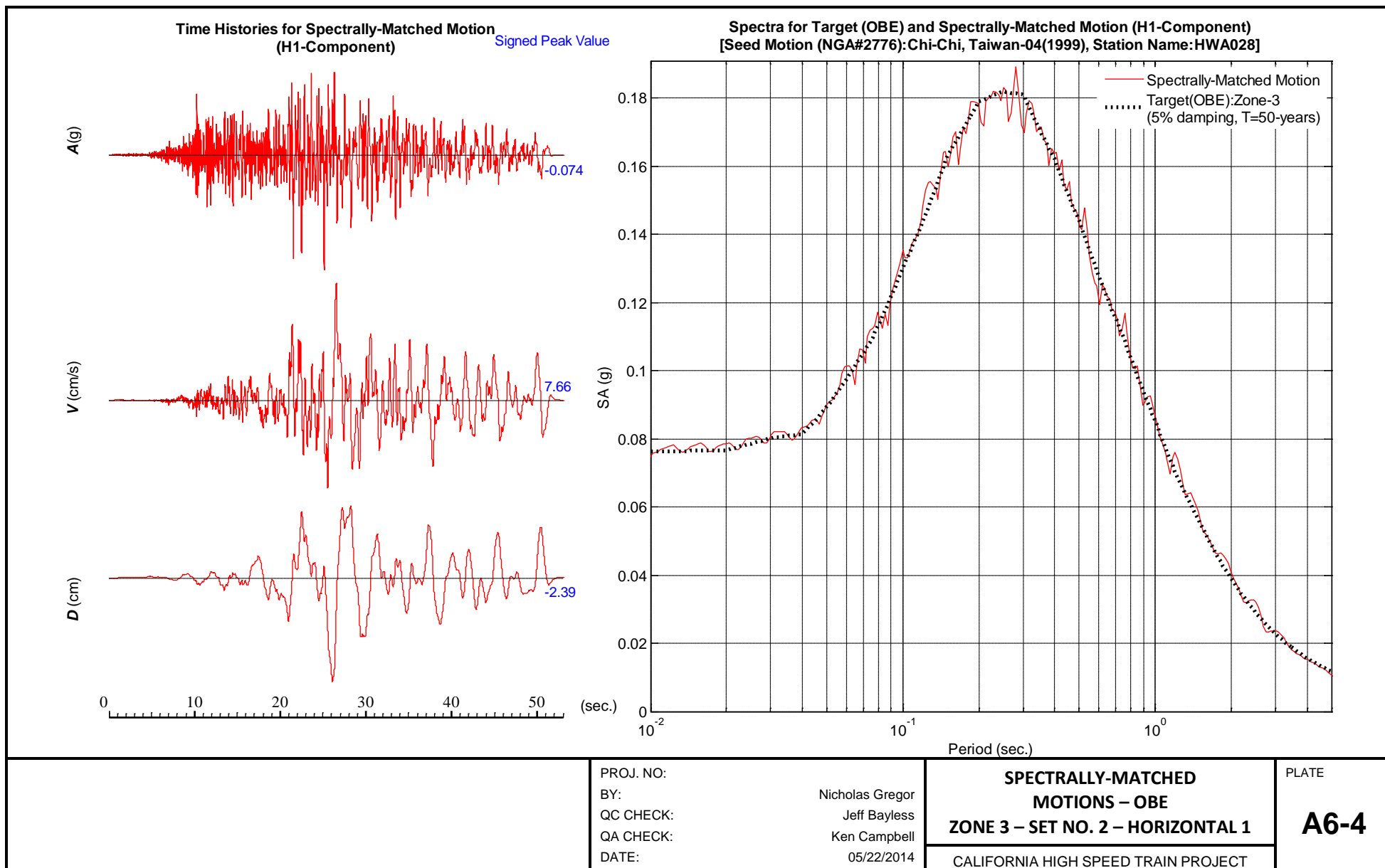


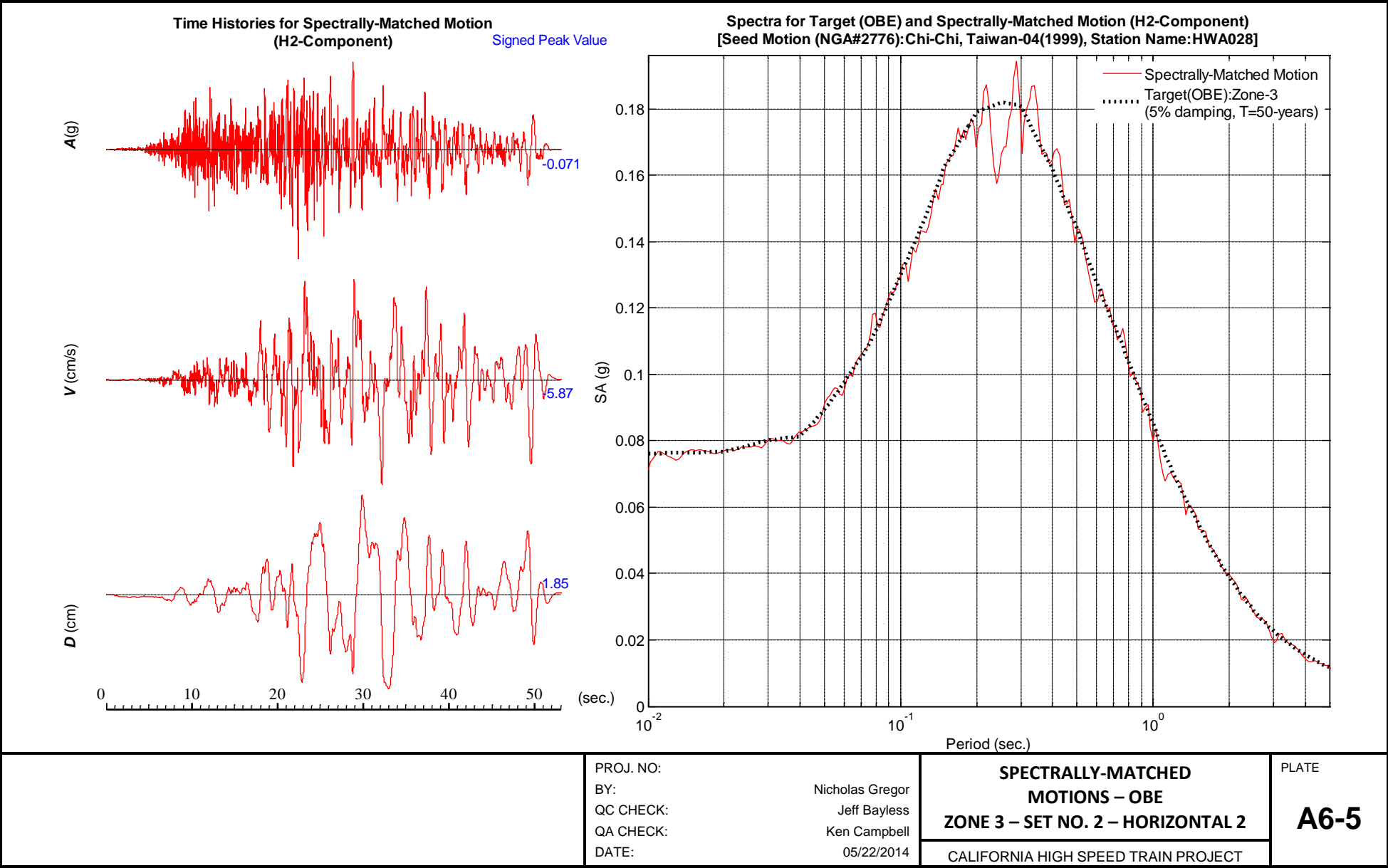


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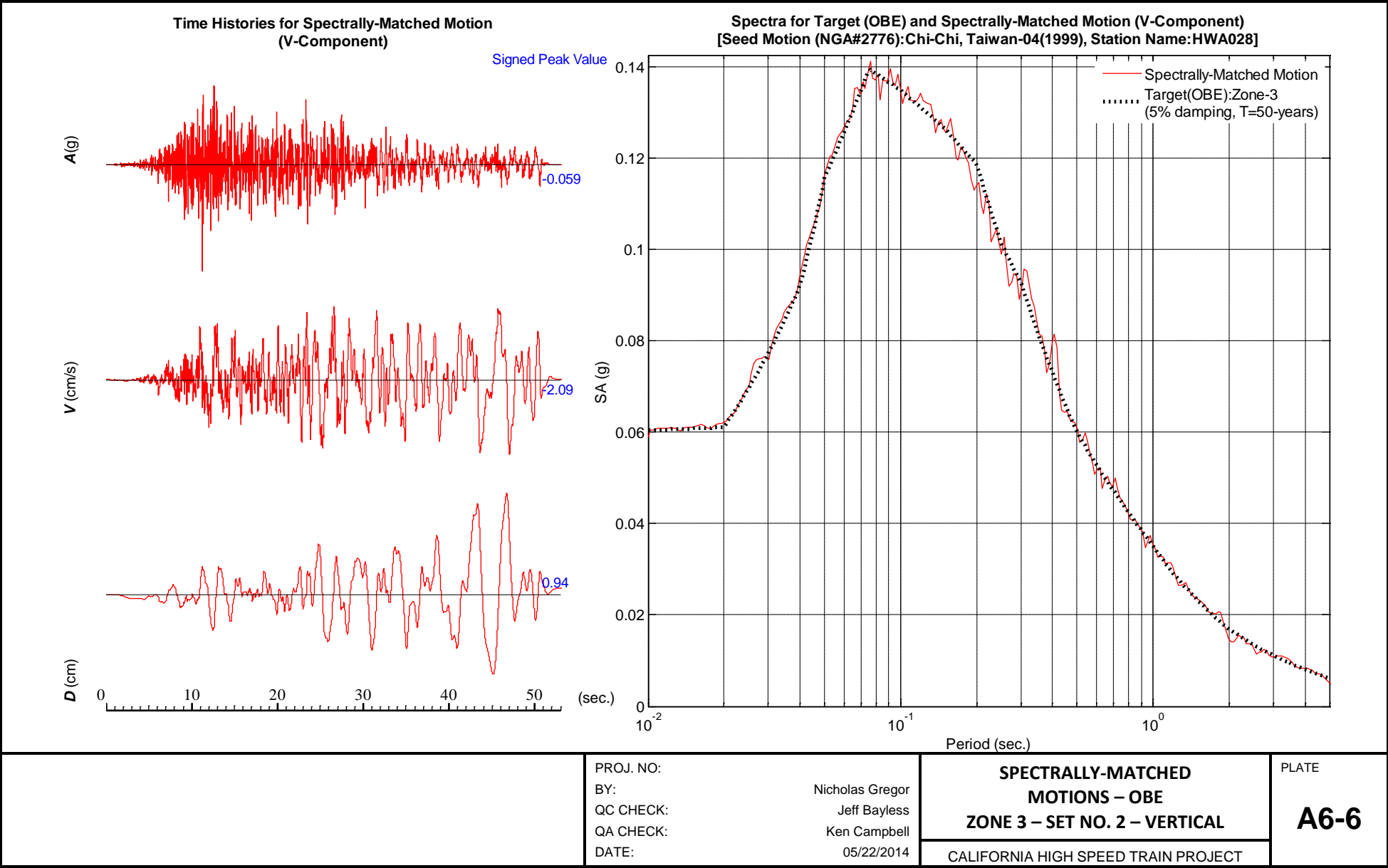


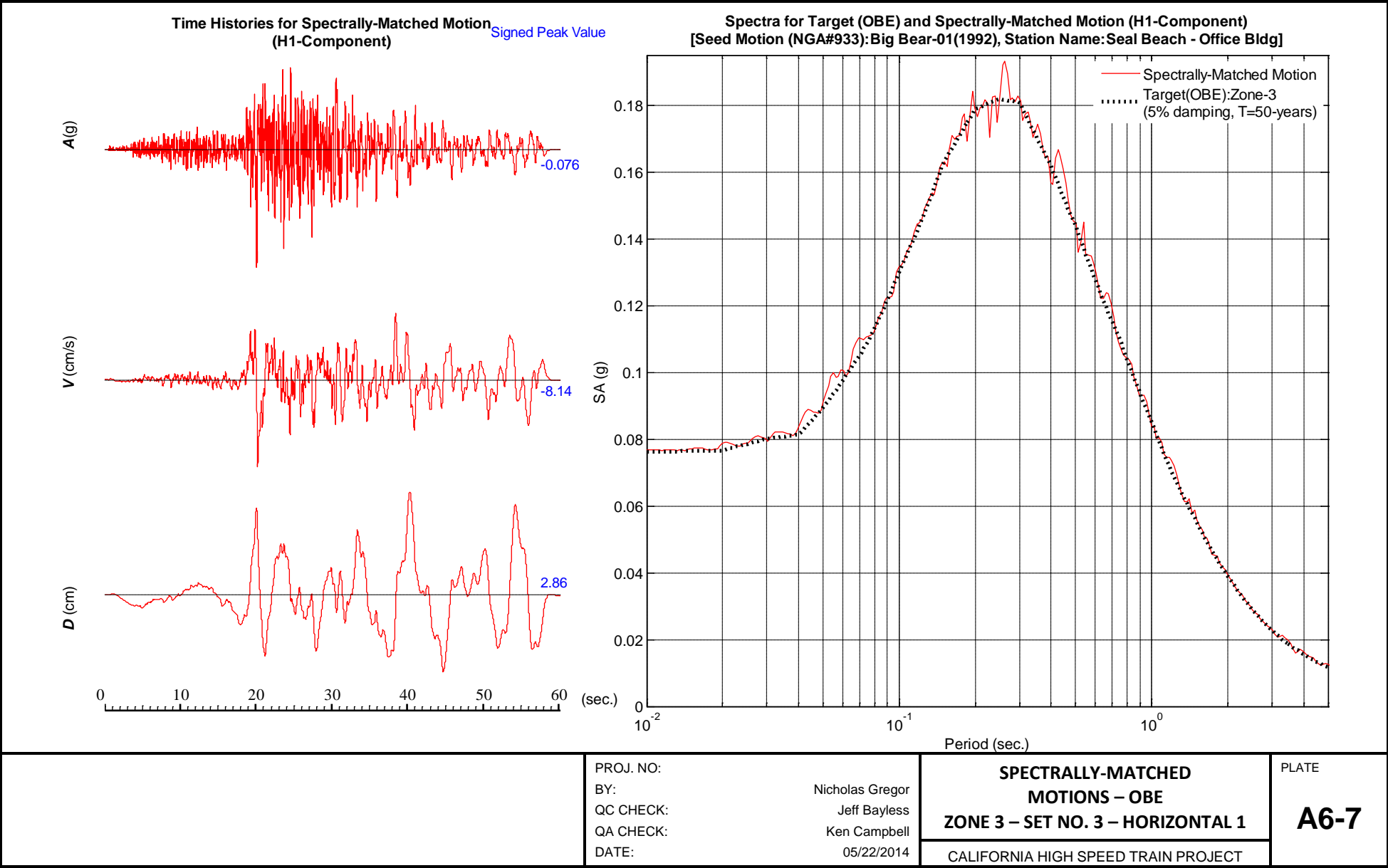
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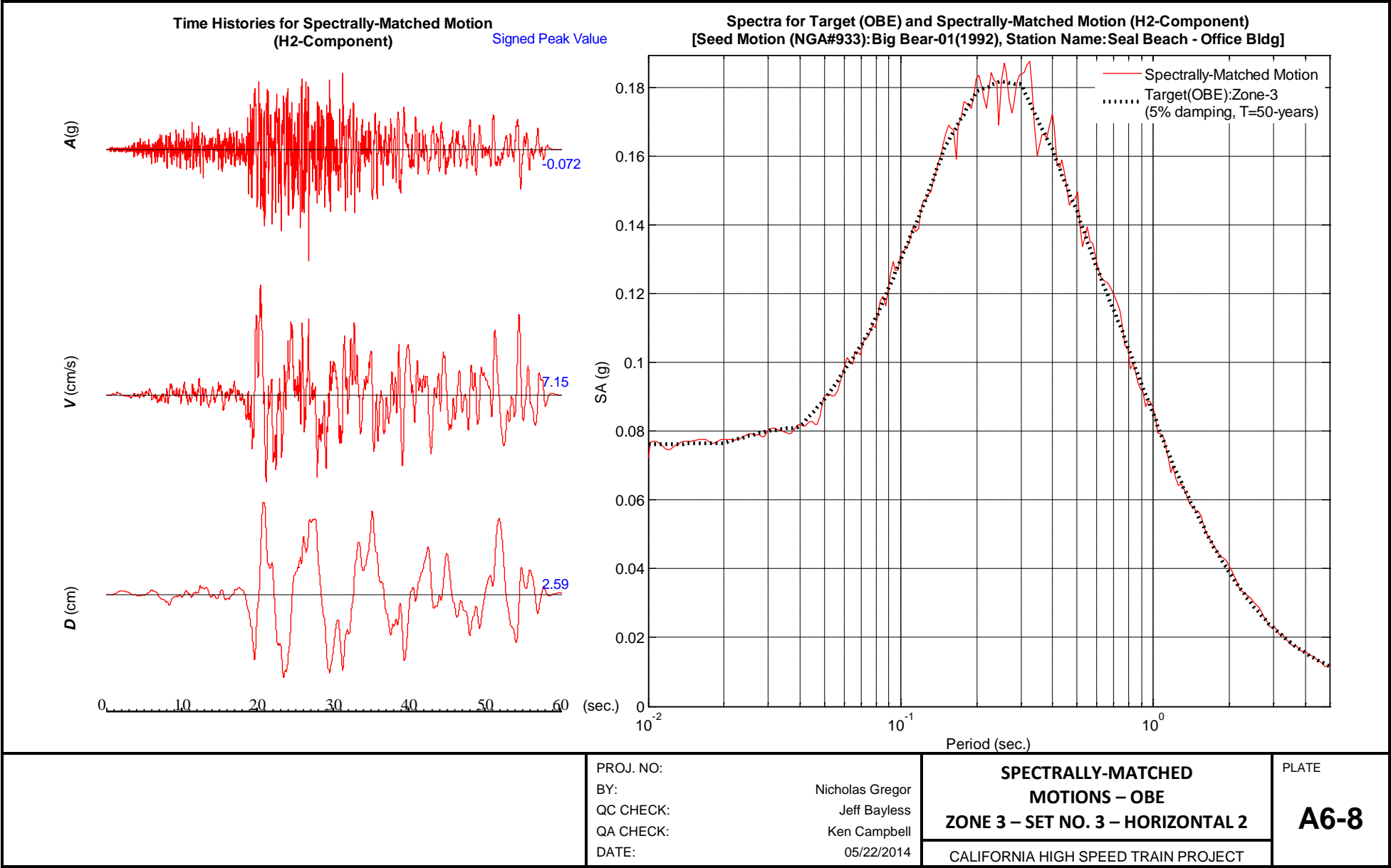


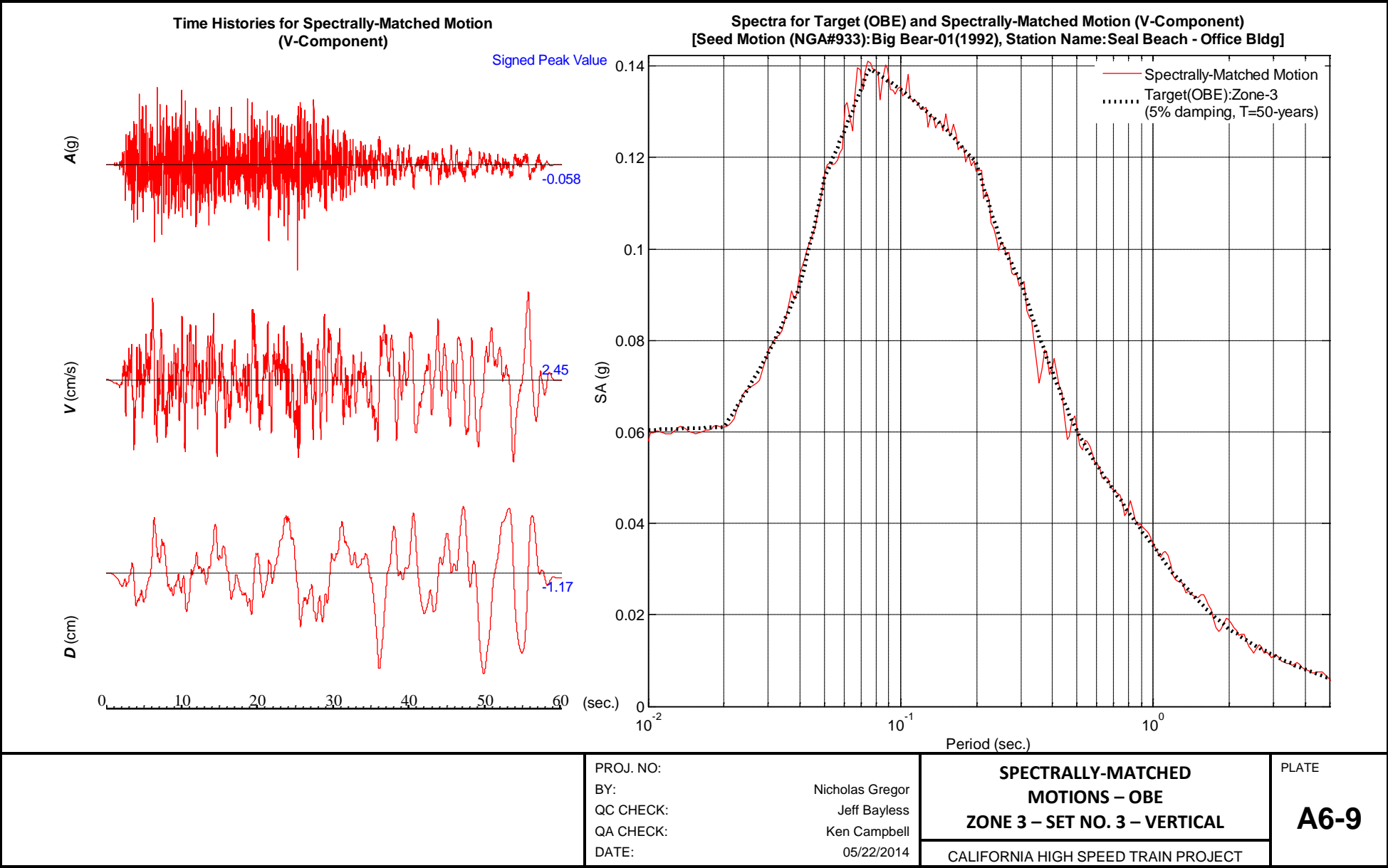
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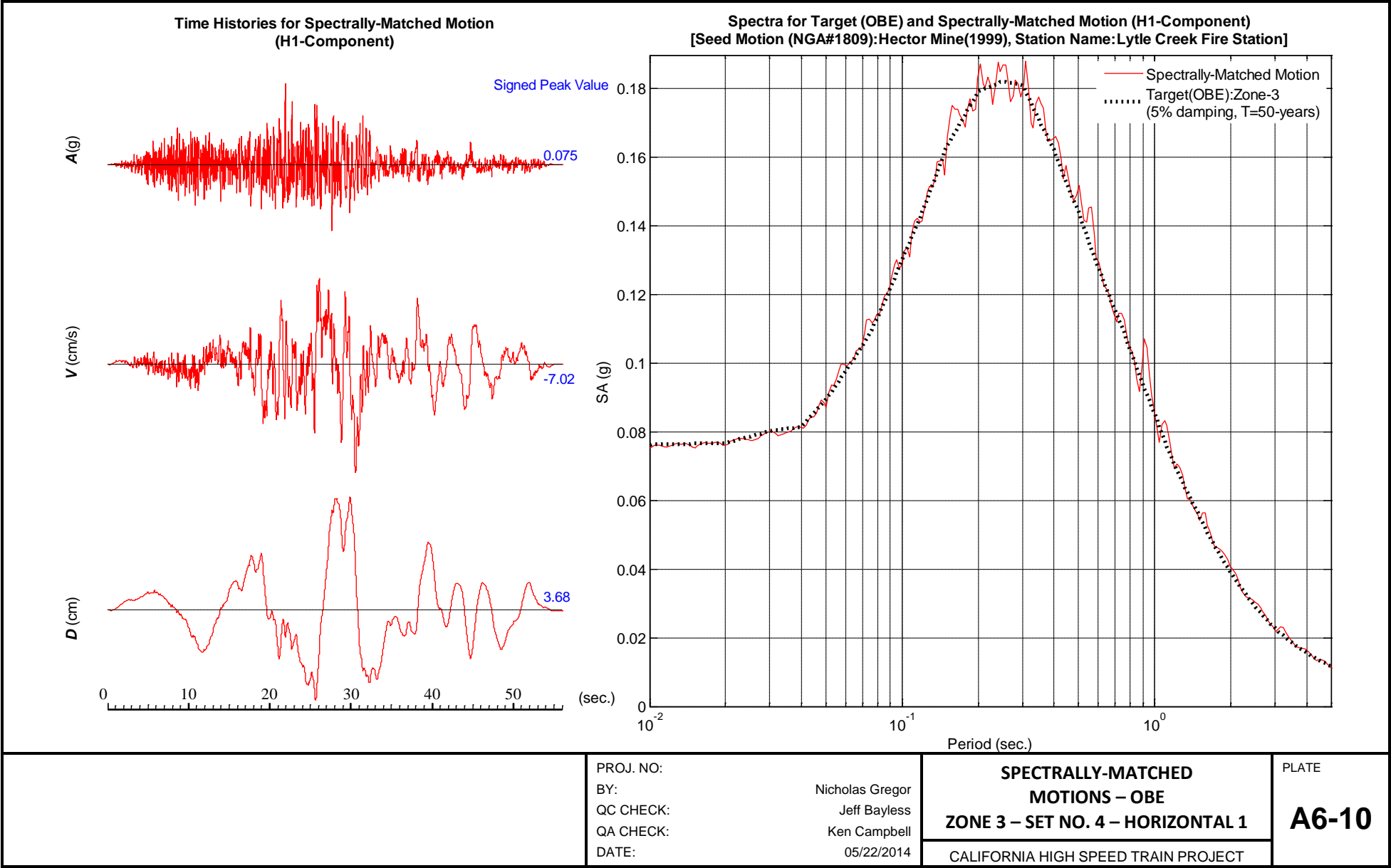


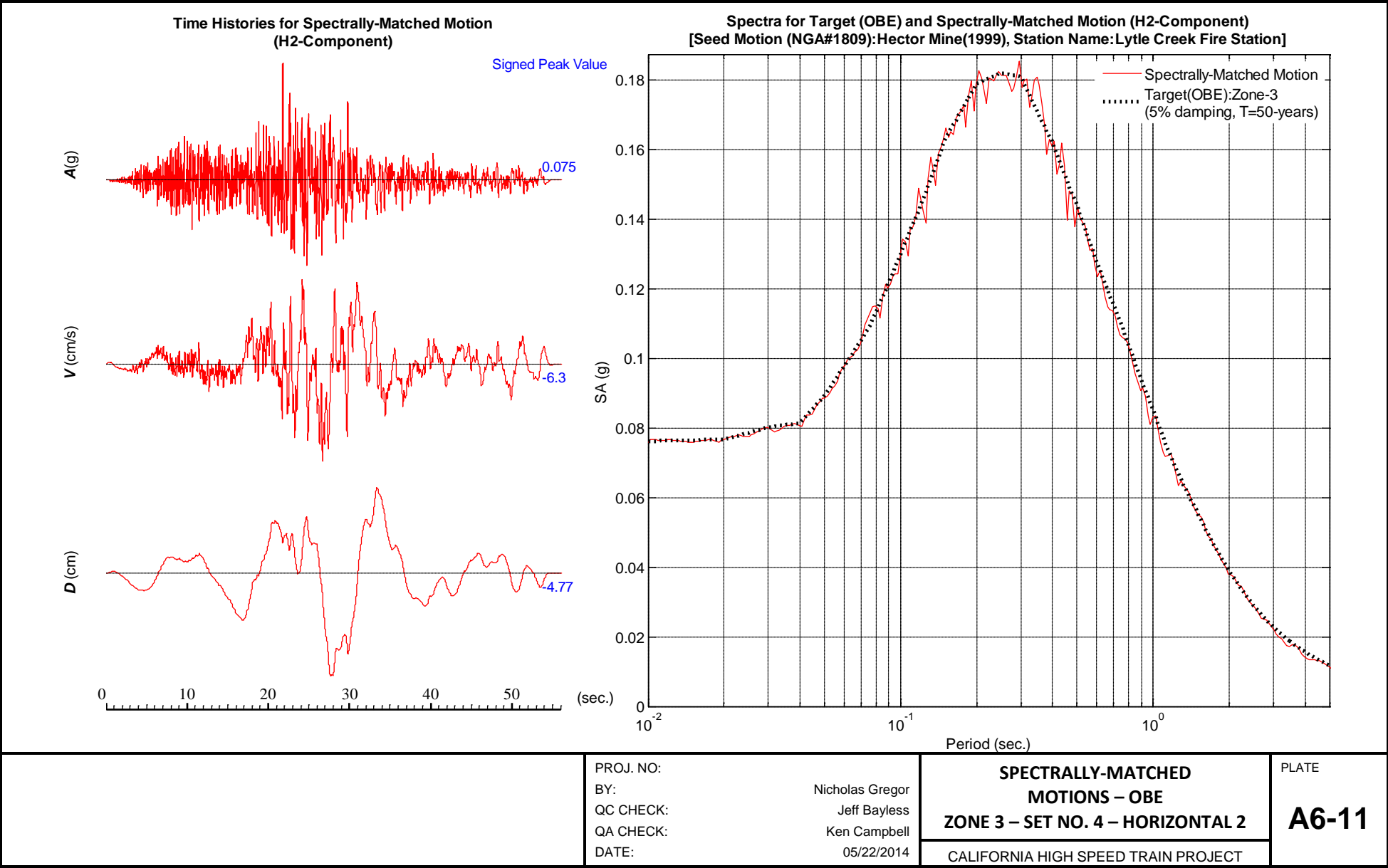


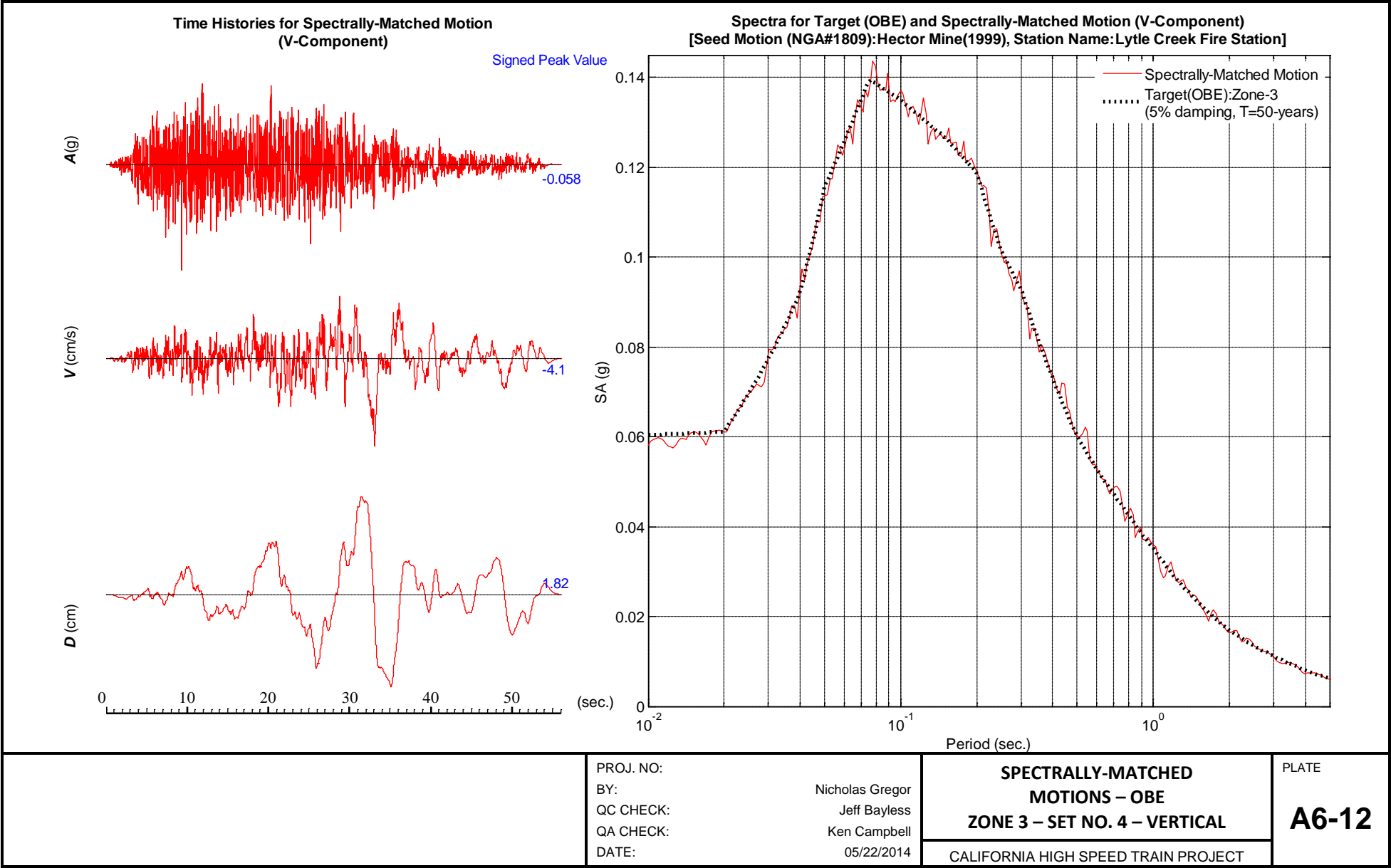




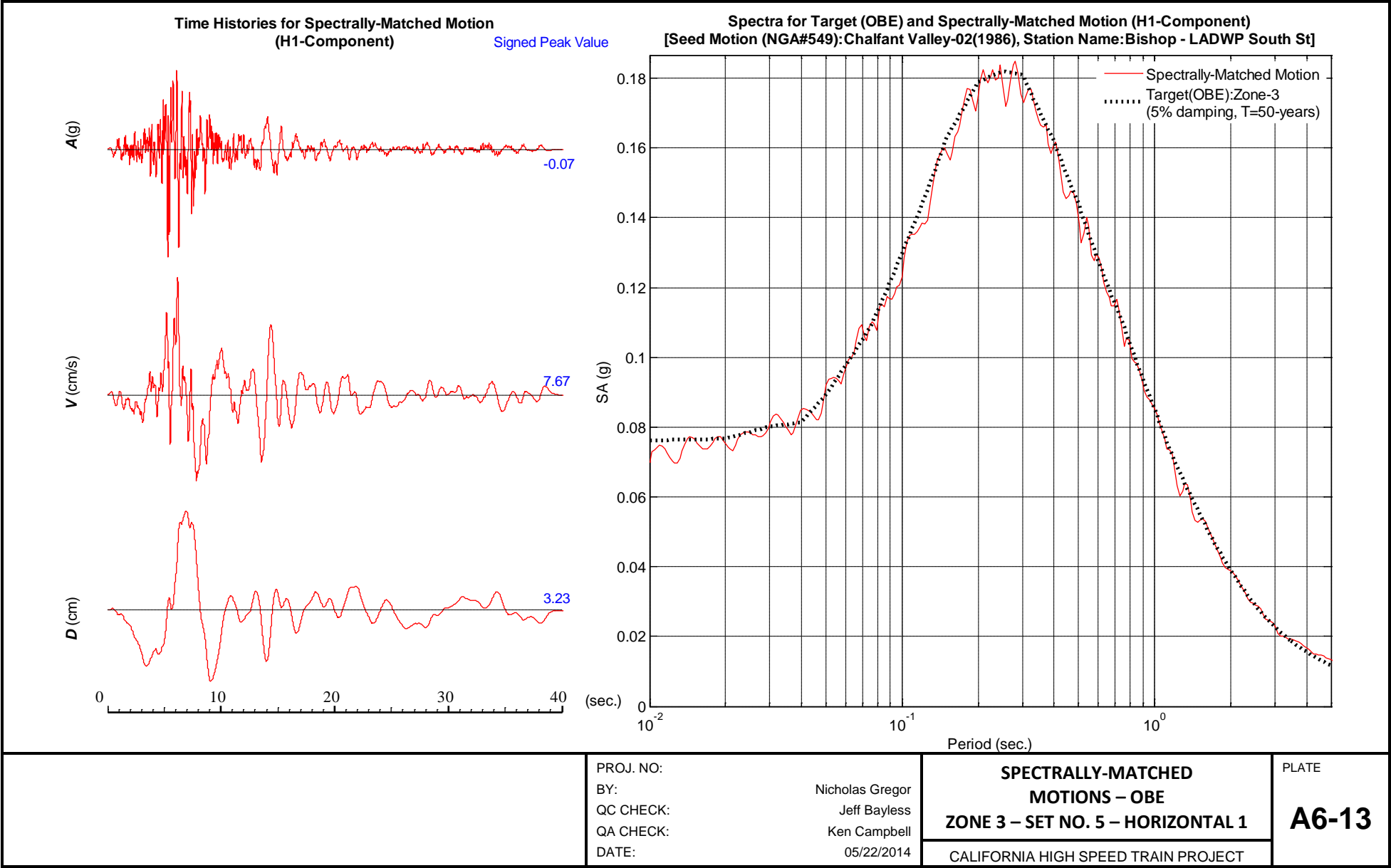
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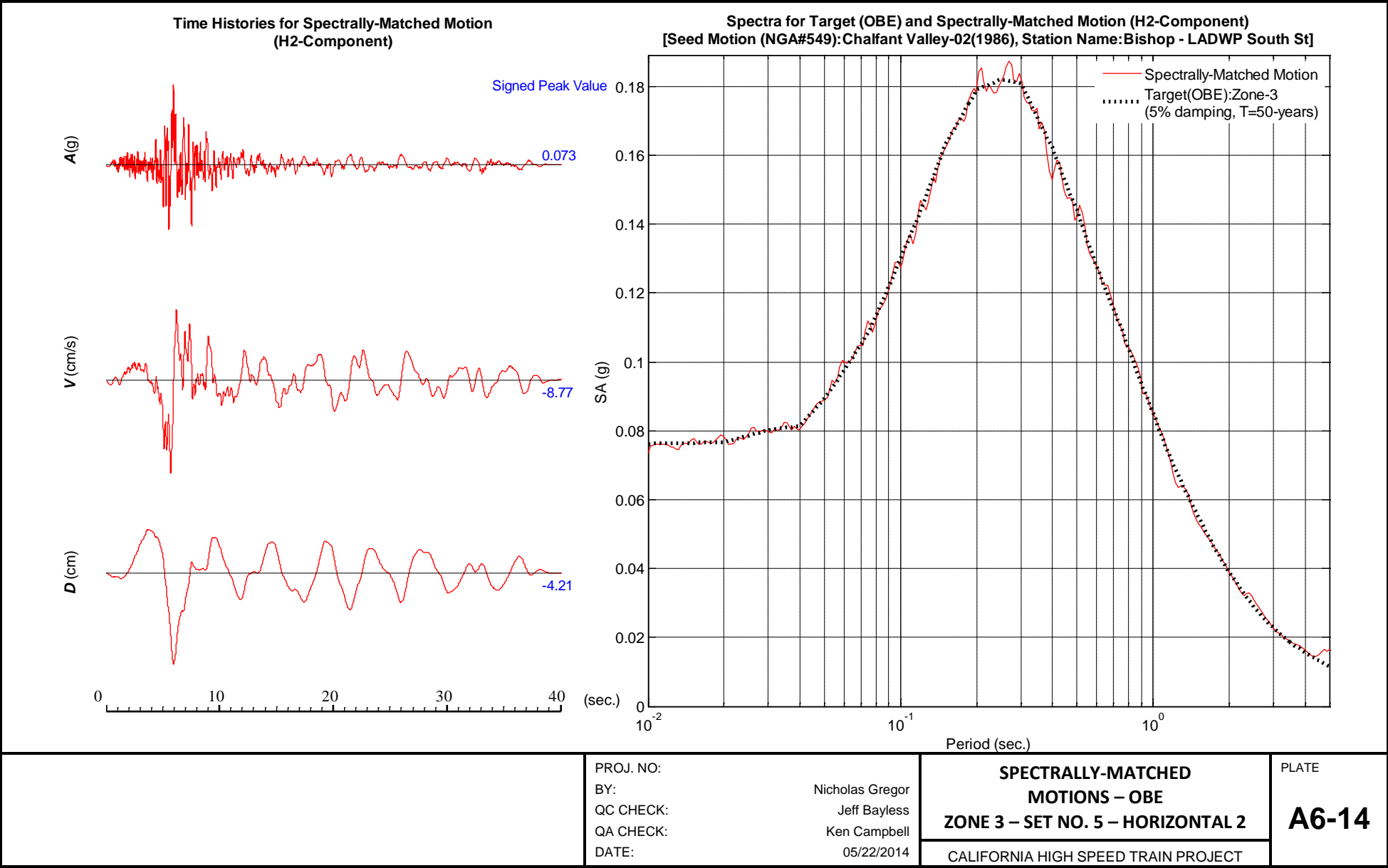


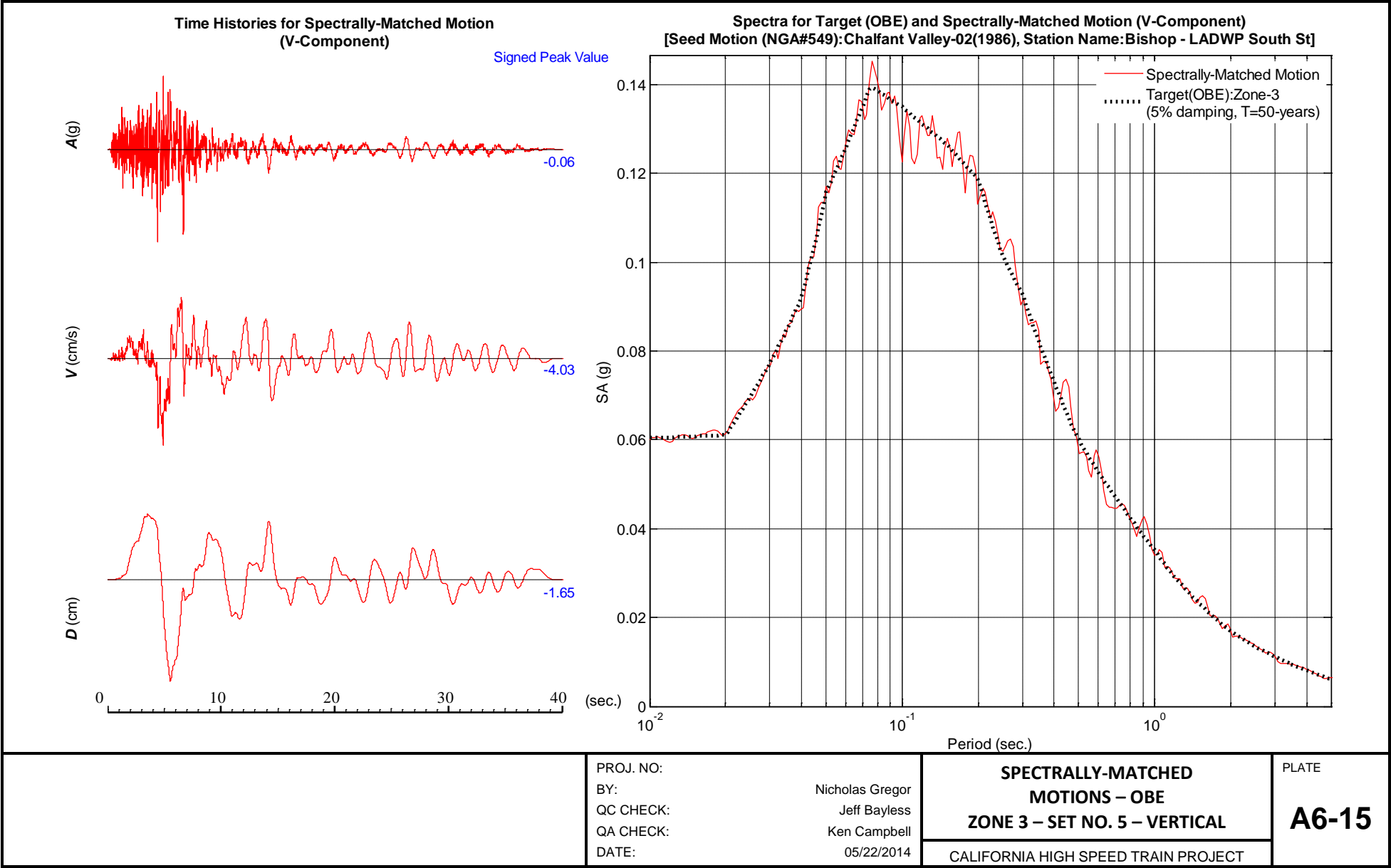




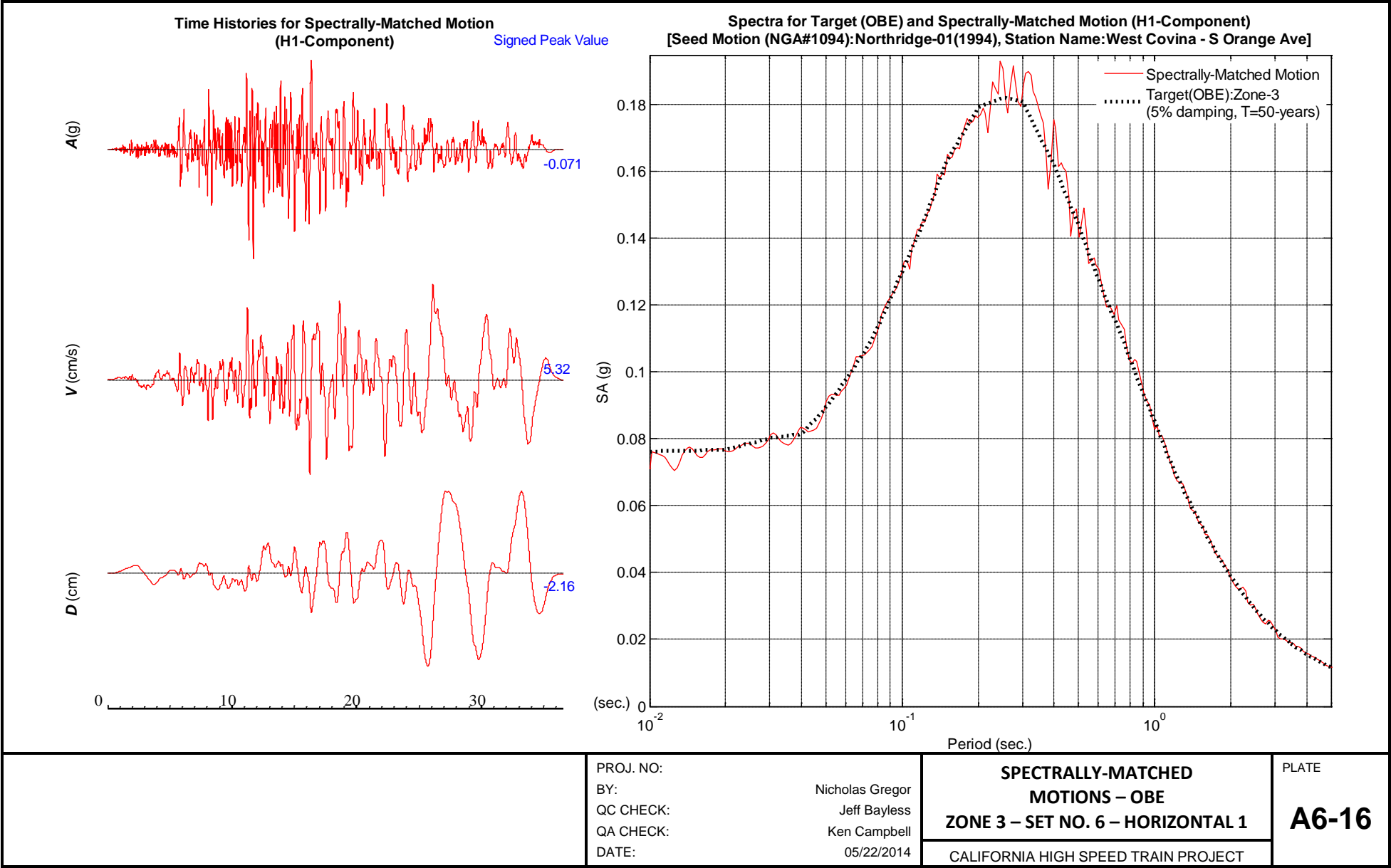
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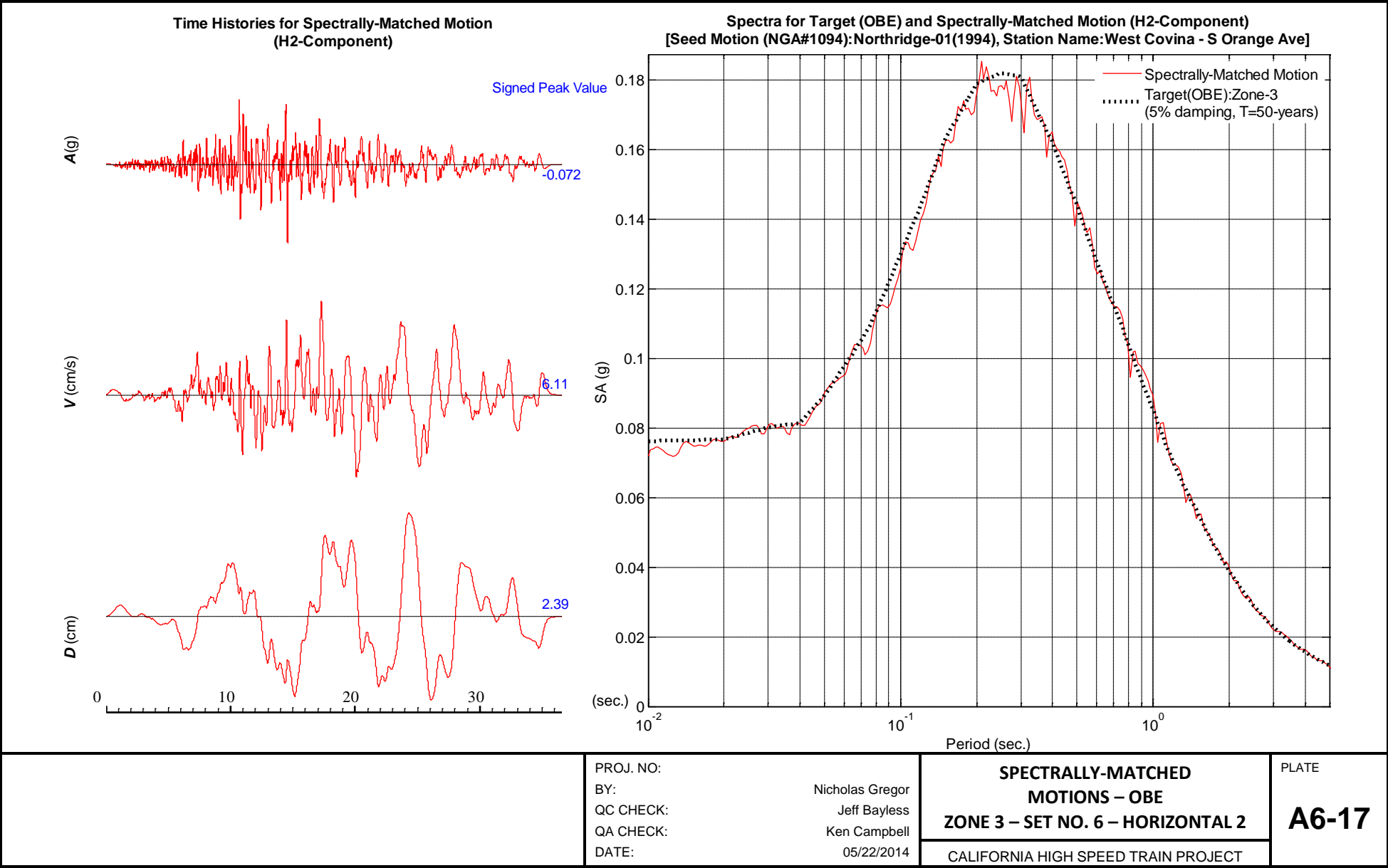


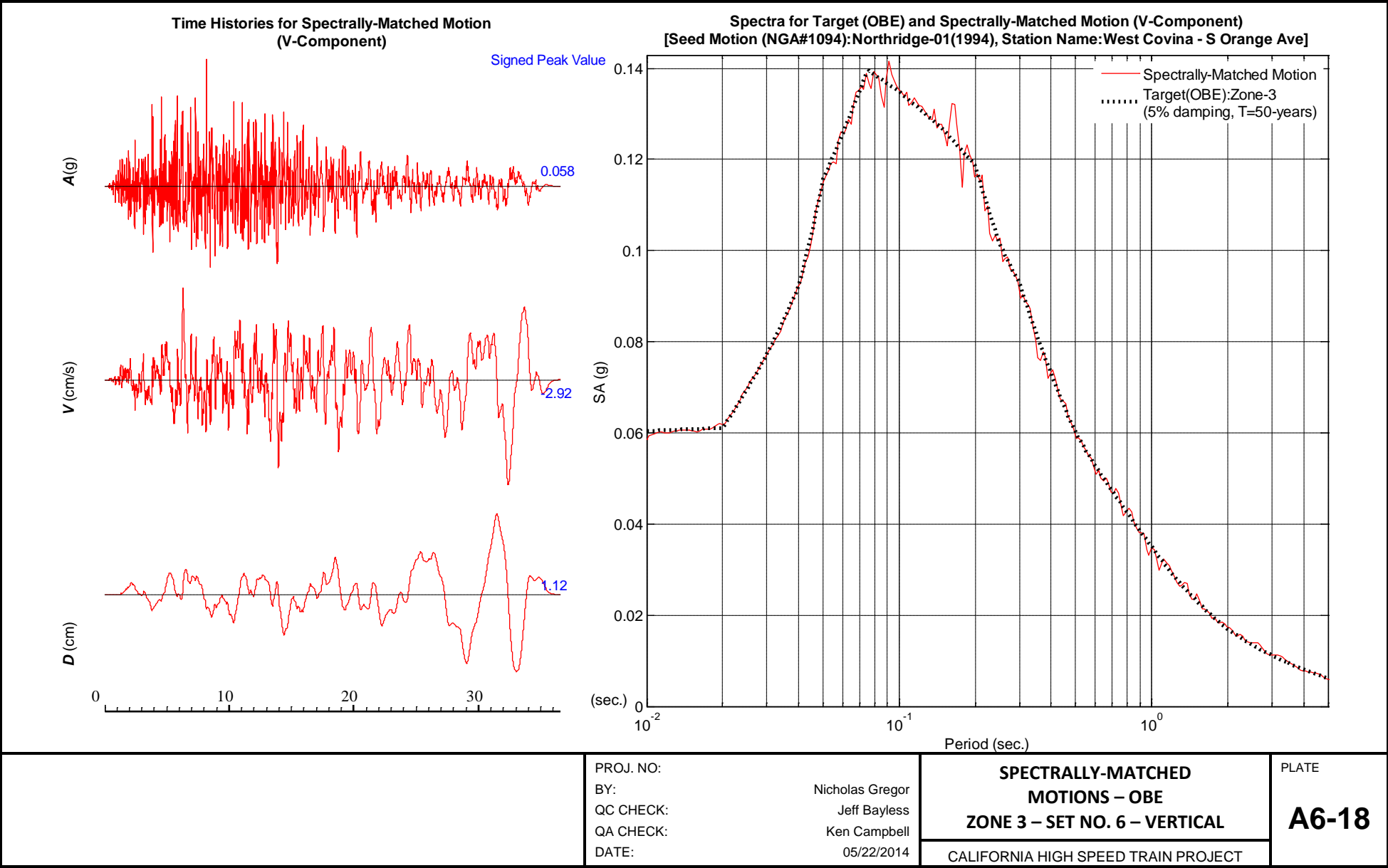


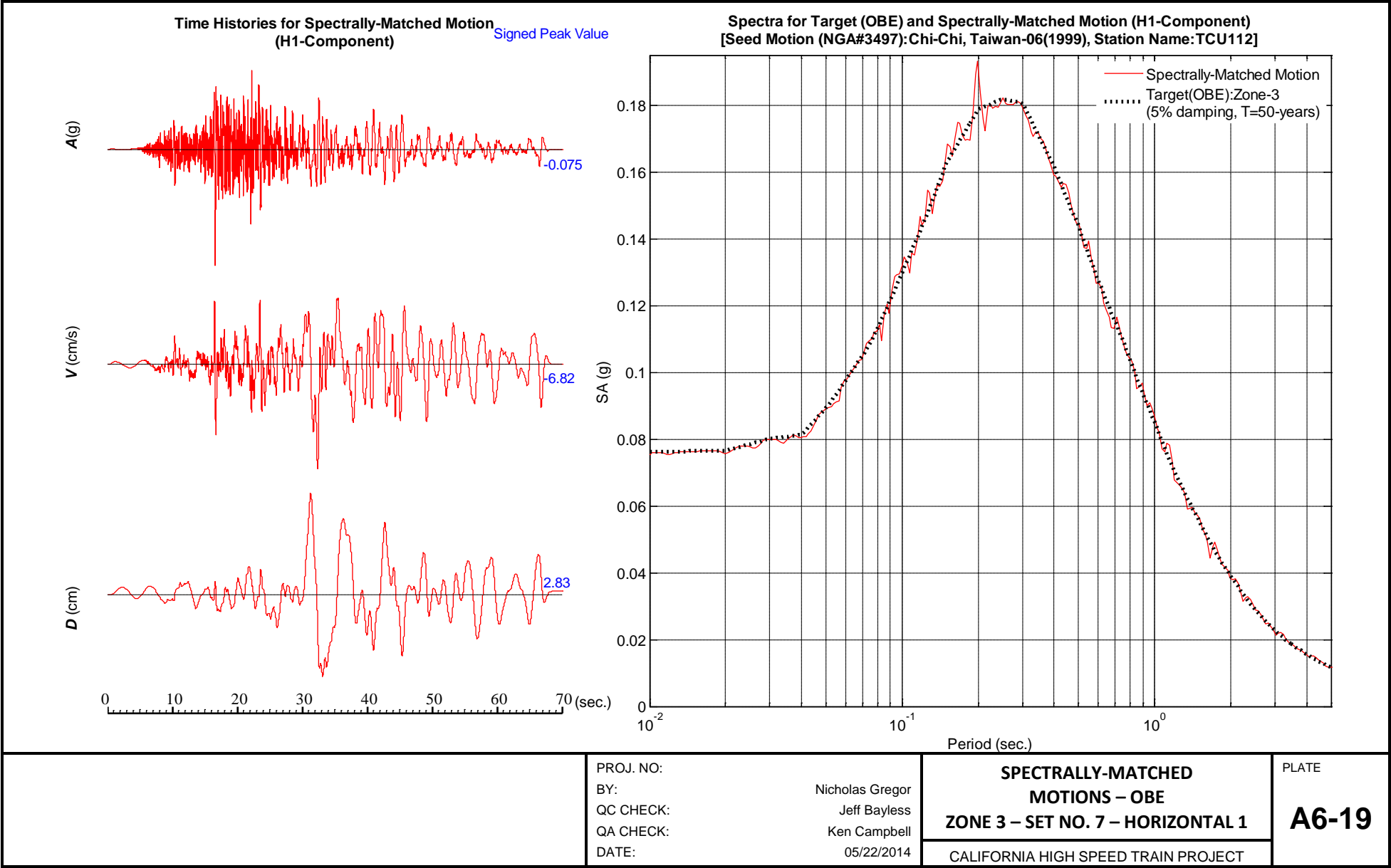


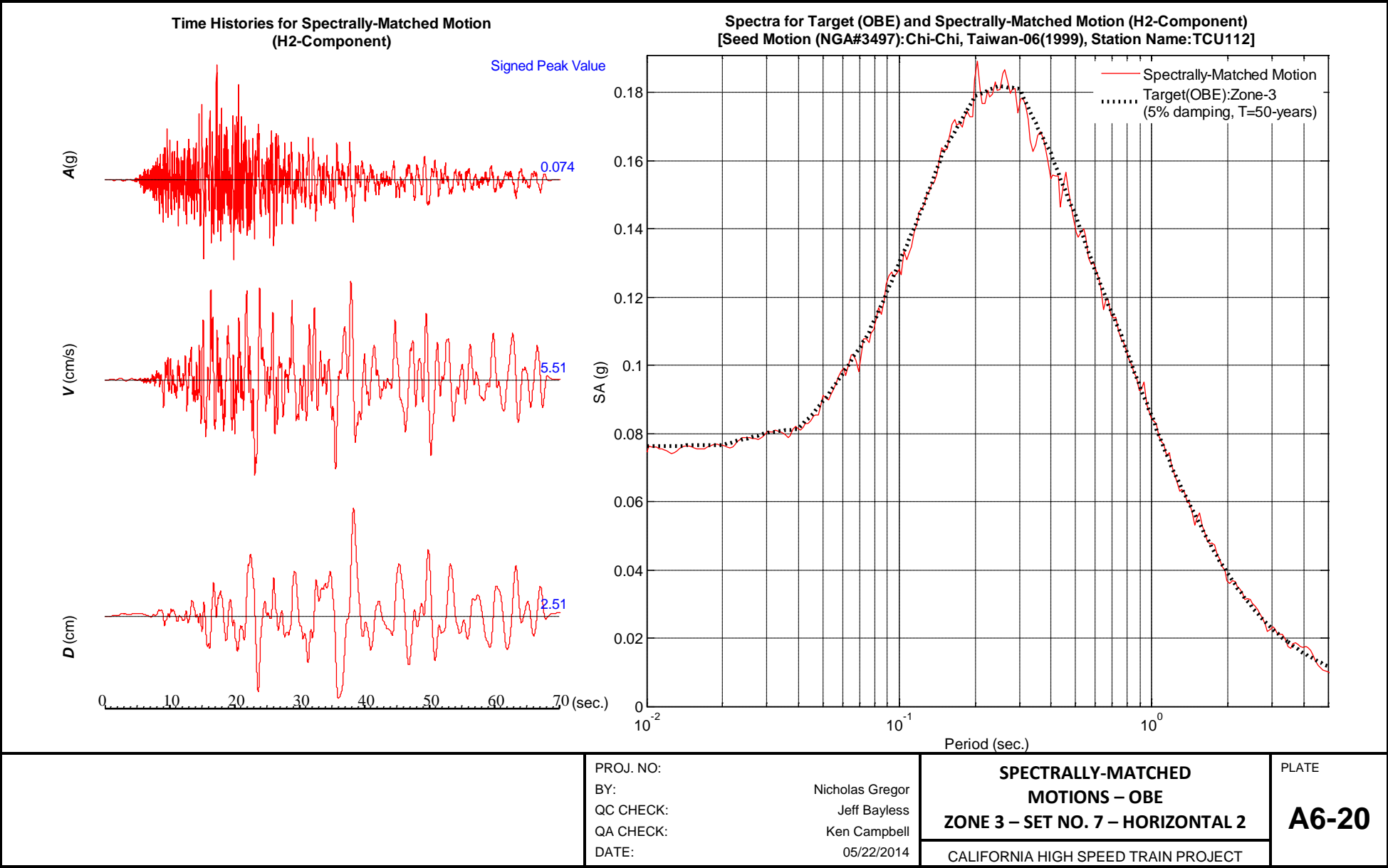


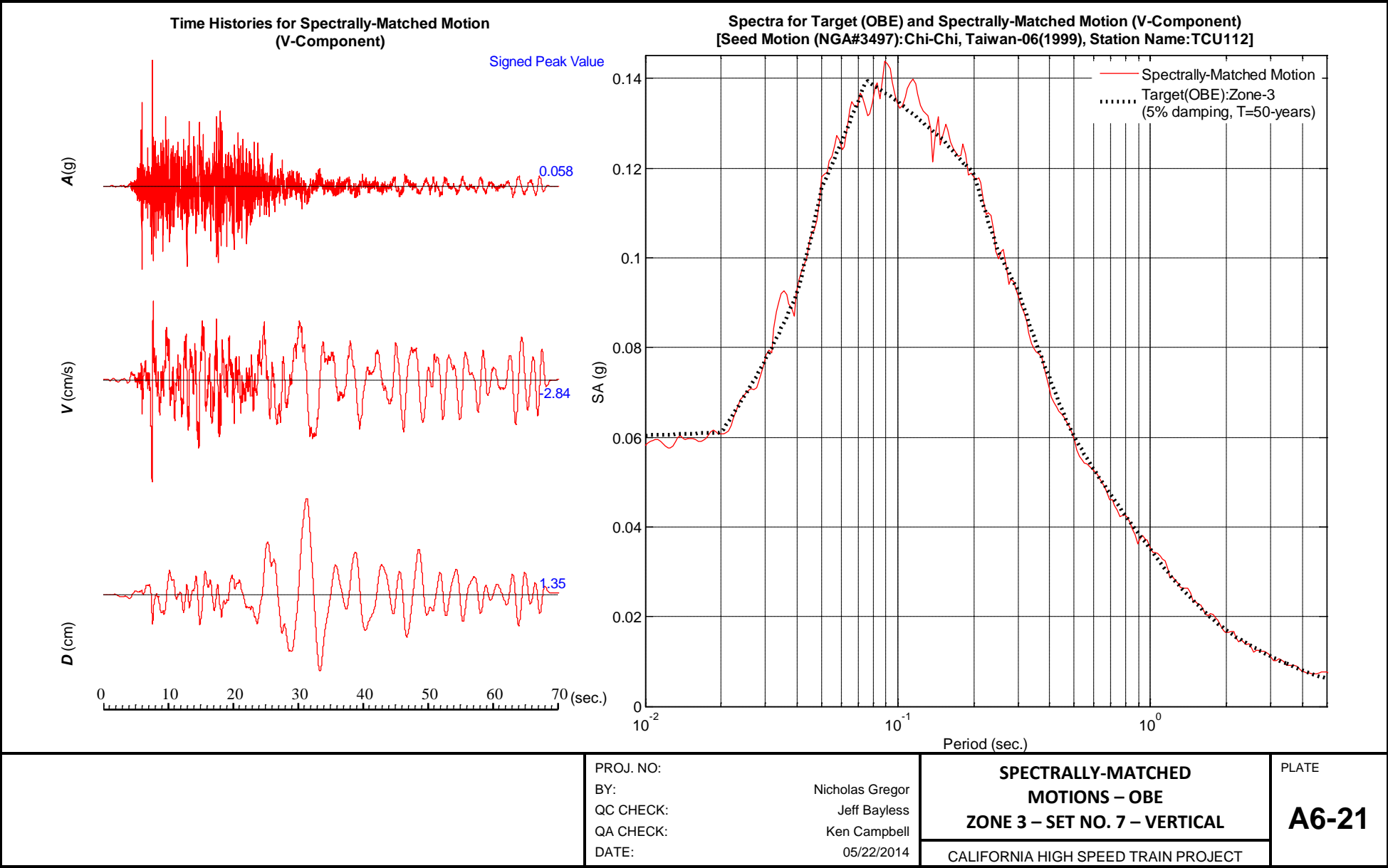












**Table C.2:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for Zone 4a**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.079	7.044	4.083	0.081	8.088	4.406	0.047	3.612	2.903
2	2776	Chi-Chi, Taiwan-04	1999	HWA028	6.20	92.39	0.080	8.384	2.702	0.080	6.641	2.137	0.045	3.075	1.160
3	933	Big Bear-01	1992	Seal Beach - Office Bldg	6.46	126.22	0.082	8.821	3.215	0.079	7.784	2.831	0.045	2.494	1.605
4	1809	Hector Mine	1999	Lytle Creek Fire Station	7.13	112.26	0.082	7.357	3.766	0.082	6.739	5.633	0.044	3.733	2.812
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.076	8.296	3.536	0.081	9.666	4.809	0.044	3.222	1.266
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.079	5.981	2.399	0.078	6.452	2.700	0.047	3.057	1.446
7	3497	Chi-Chi, Taiwan-06	1999	TCU112	6.30	51.72	0.082	7.469	3.073	0.082	6.151	2.803	0.047	2.906	1.124

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DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

05/30/2014

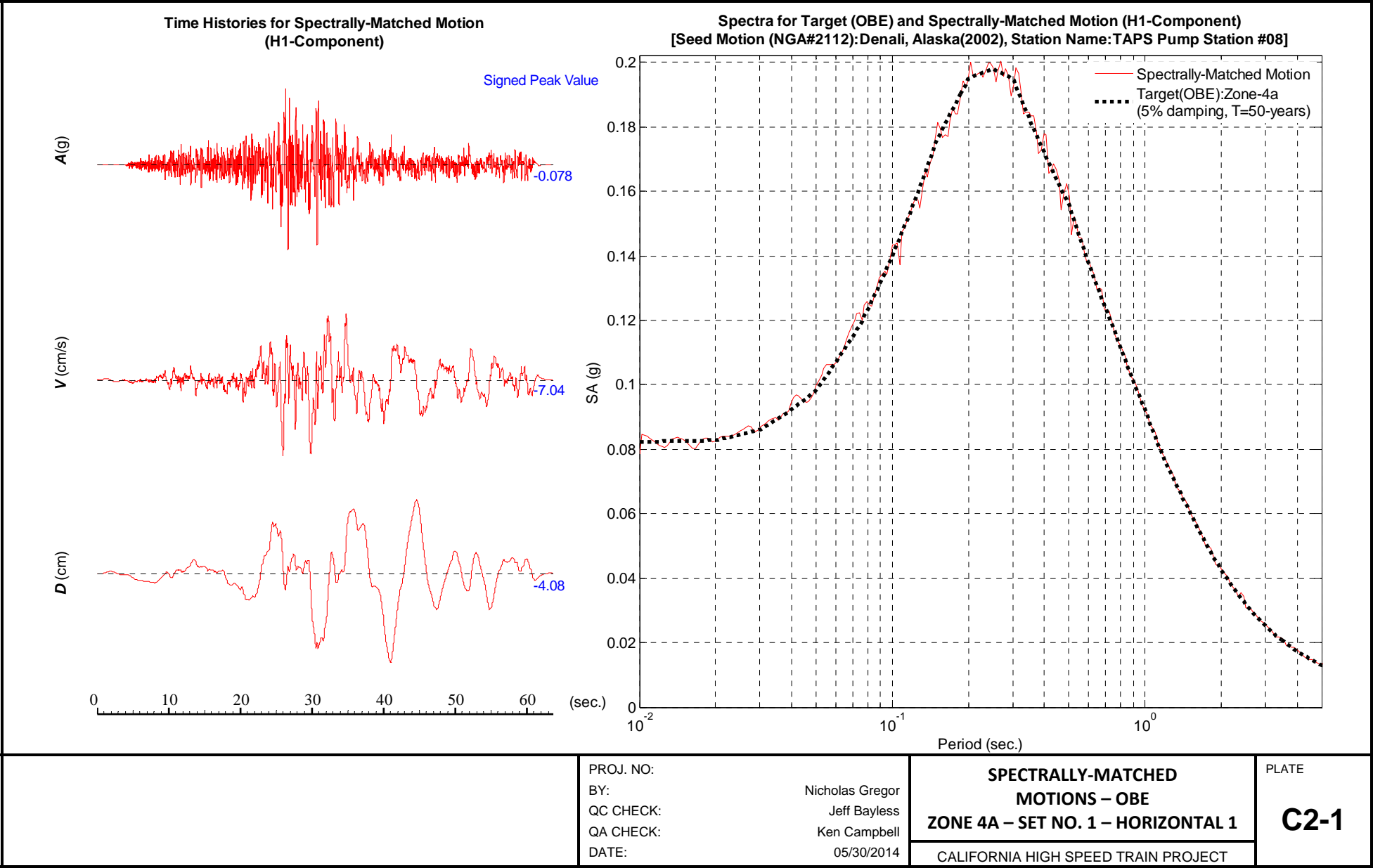
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
OBE – ZONE 4A**

CALIFORNIA HIGH SPEED TRAIN PROJECT

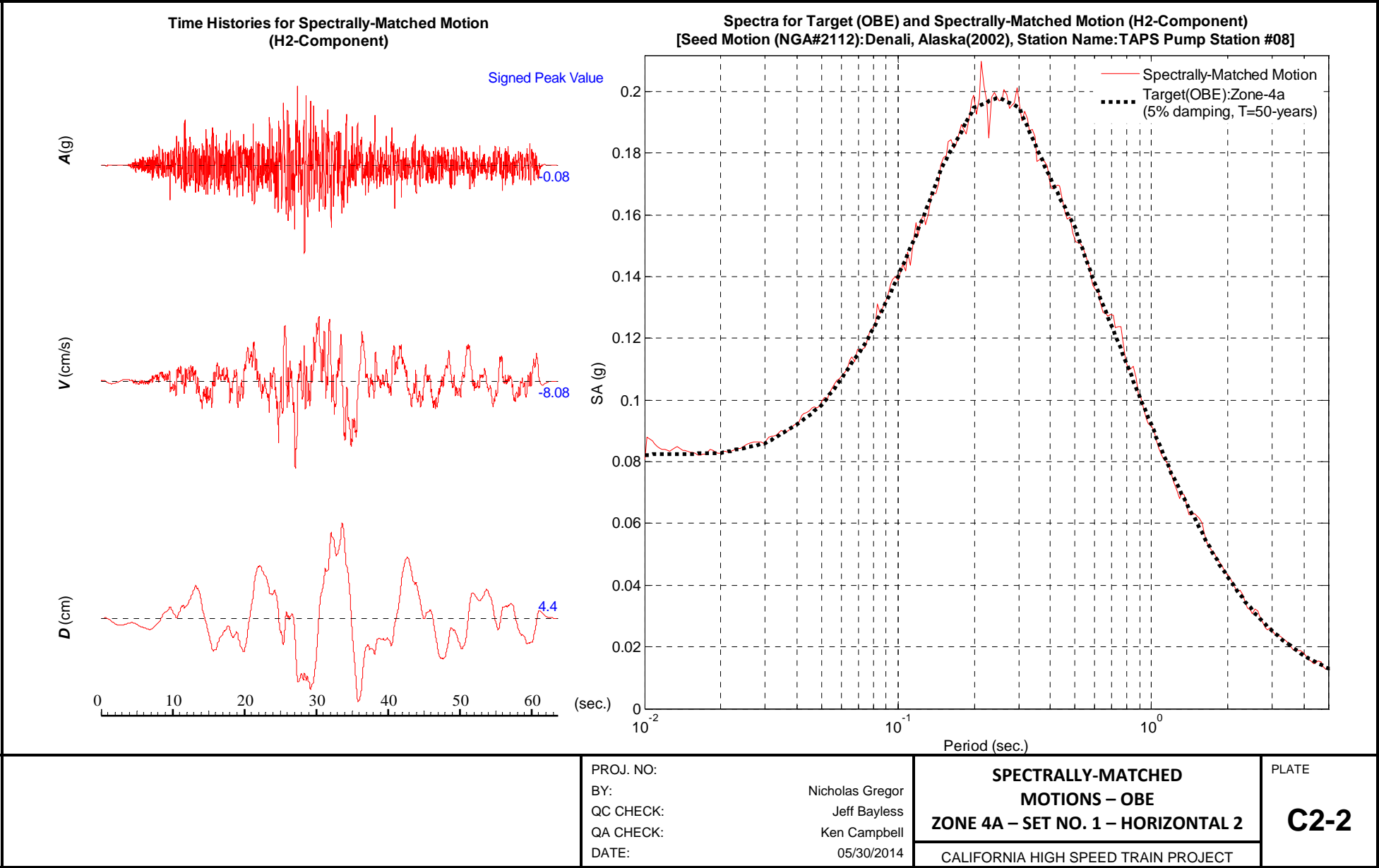
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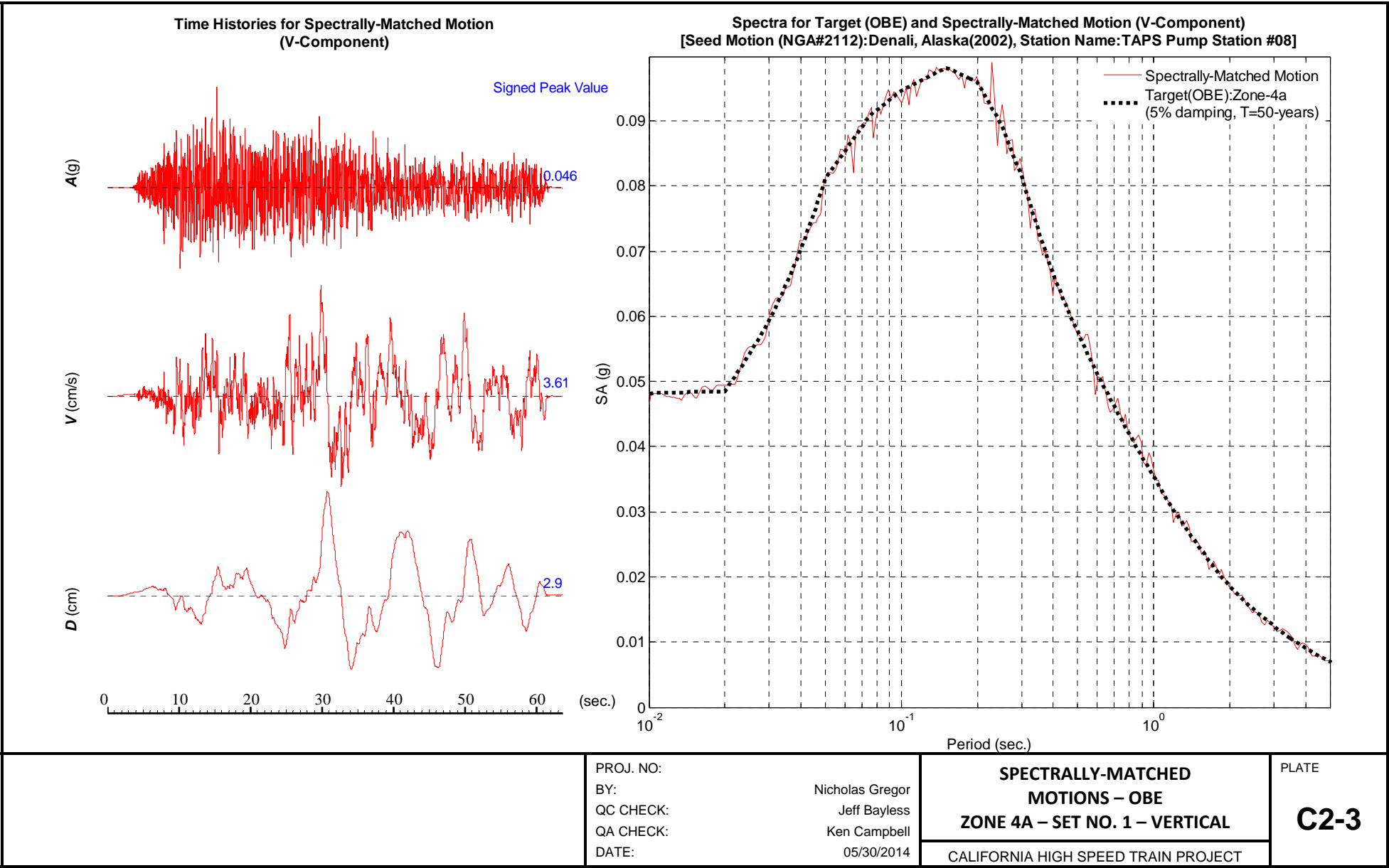
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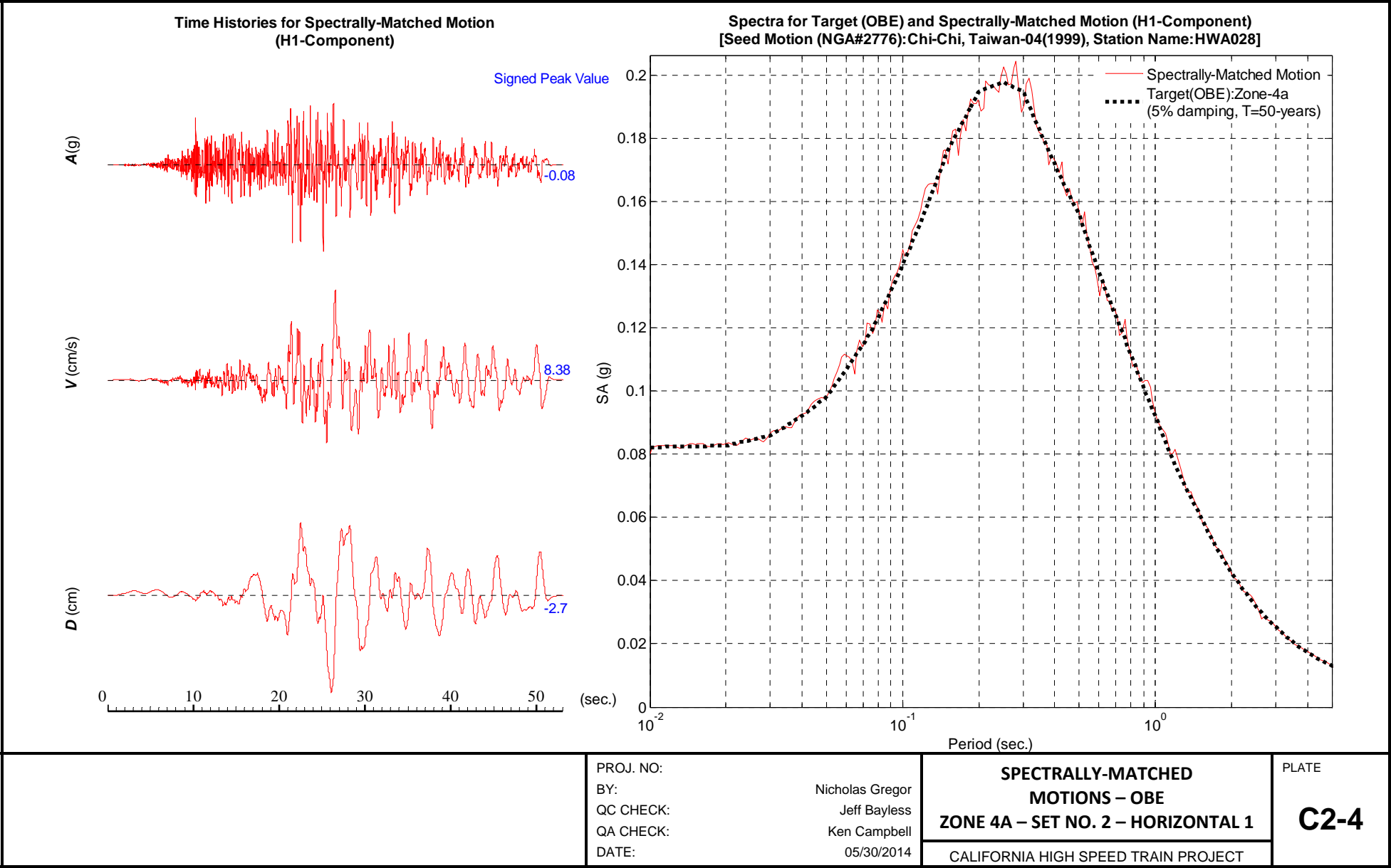
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

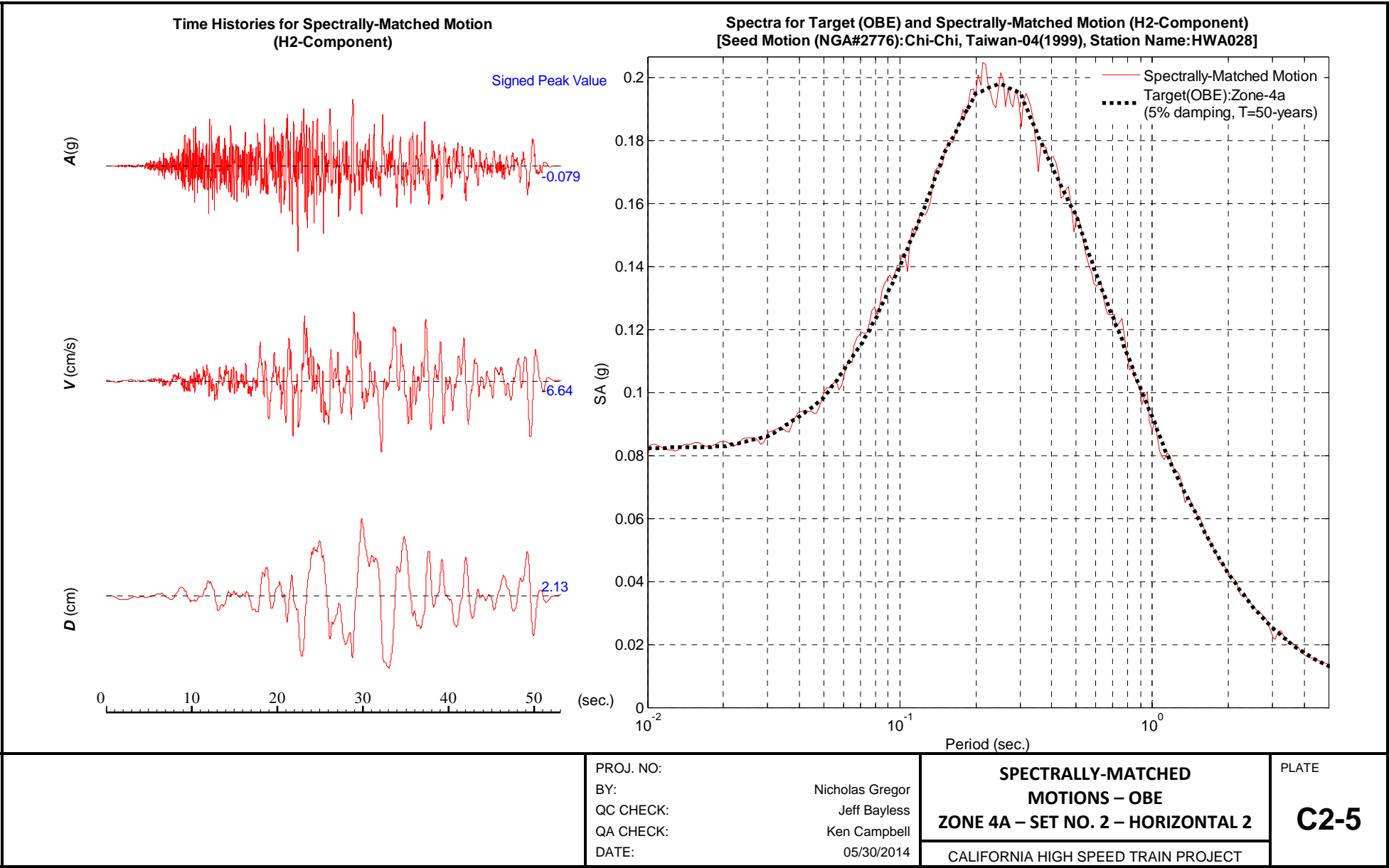


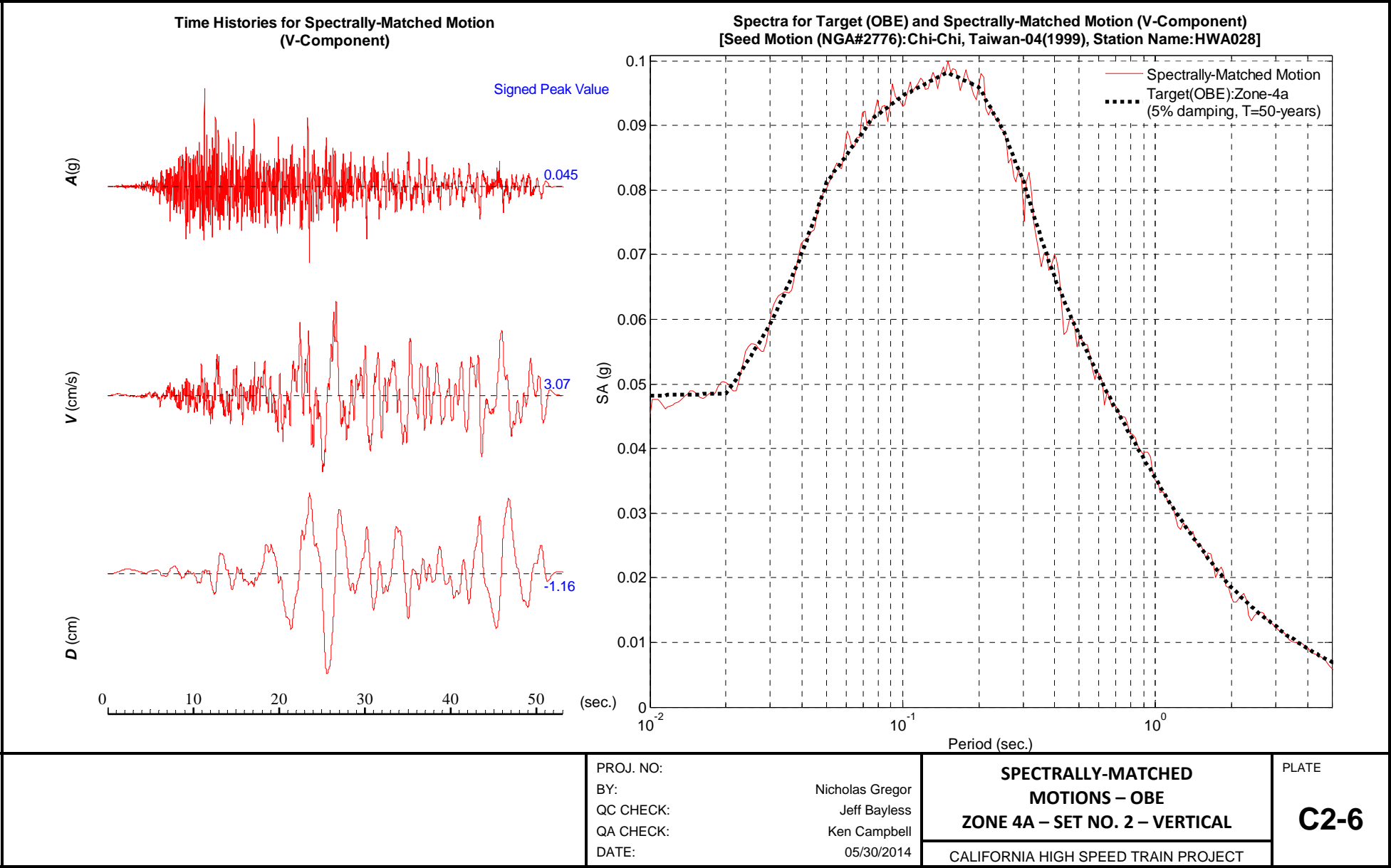


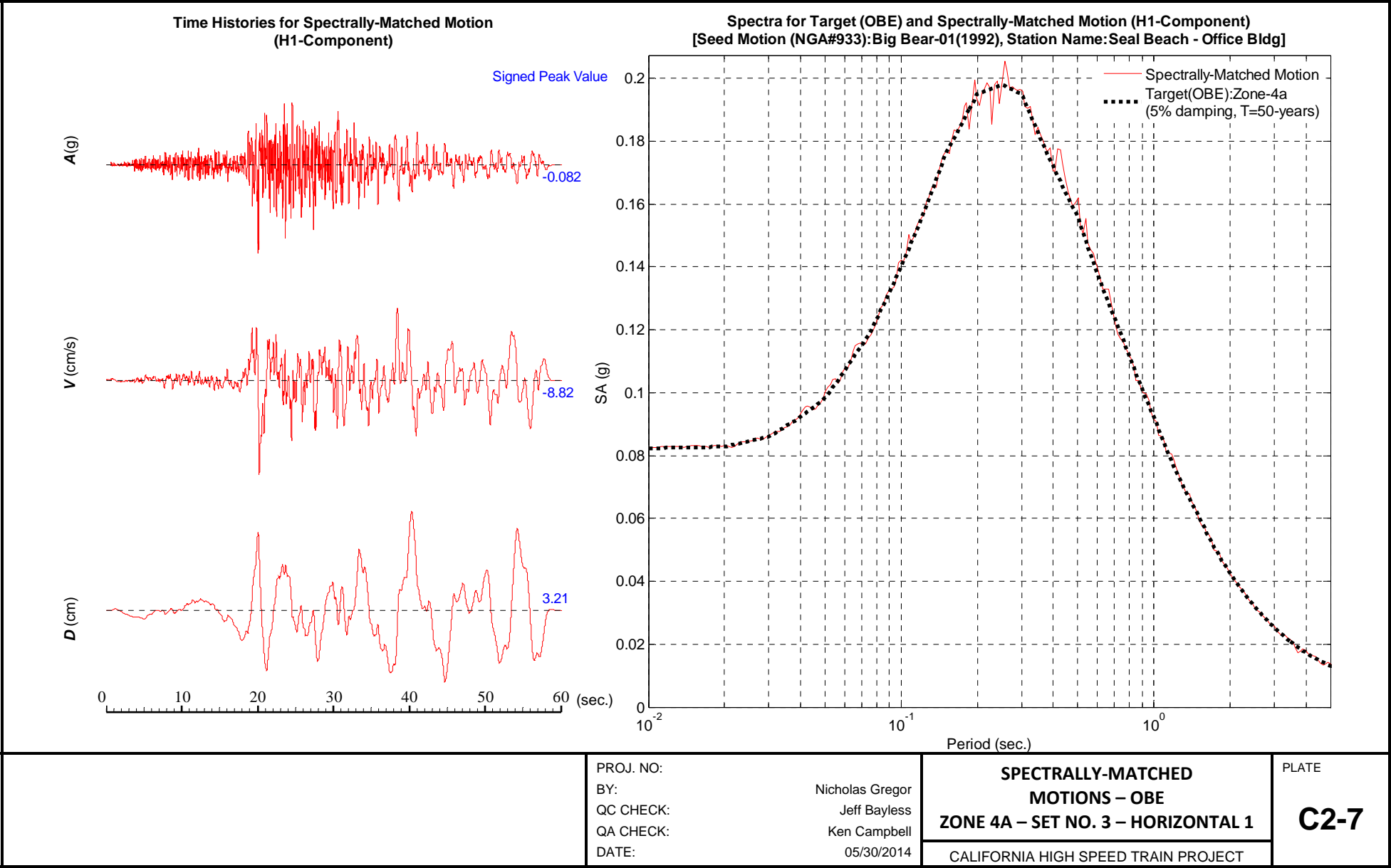


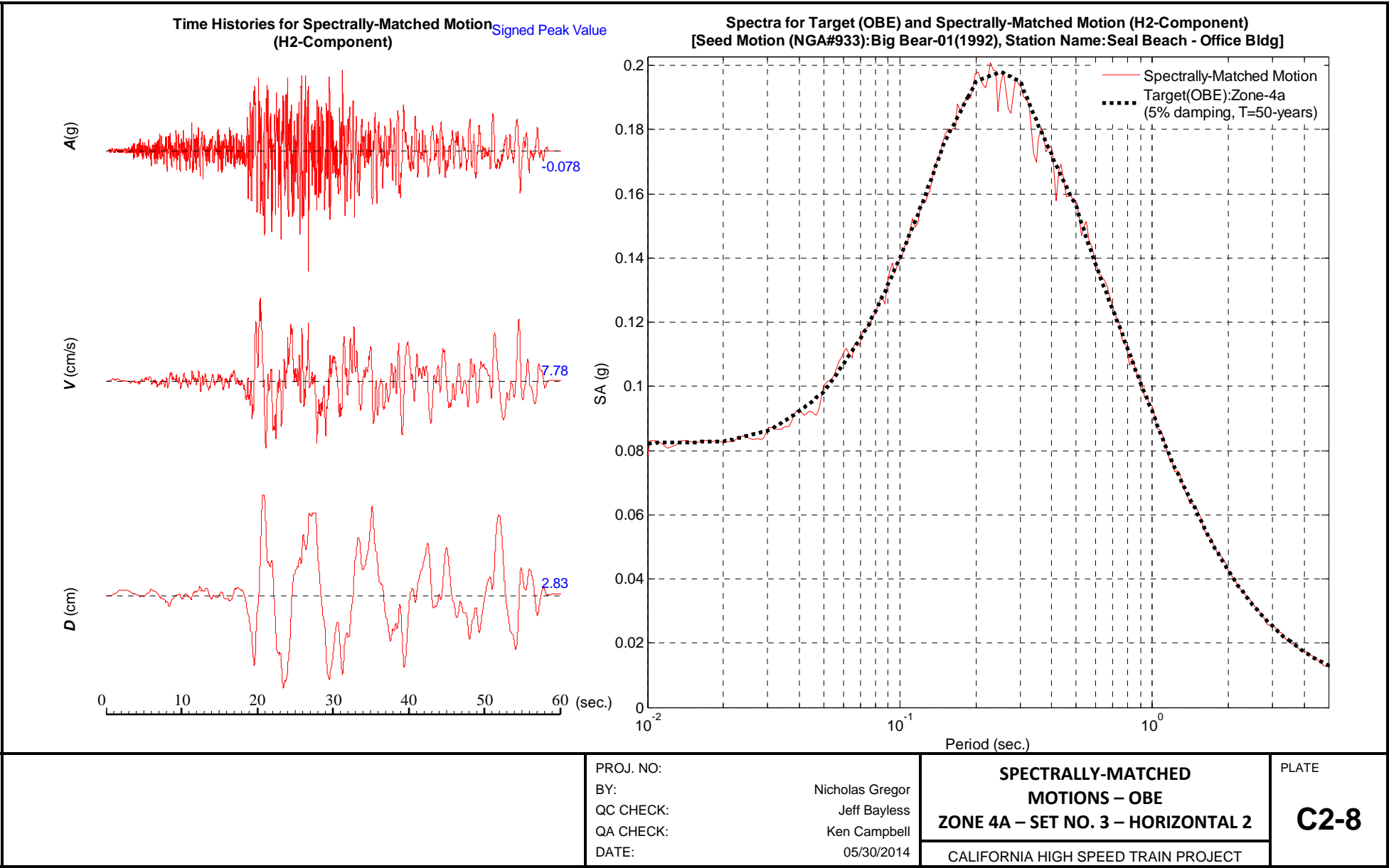


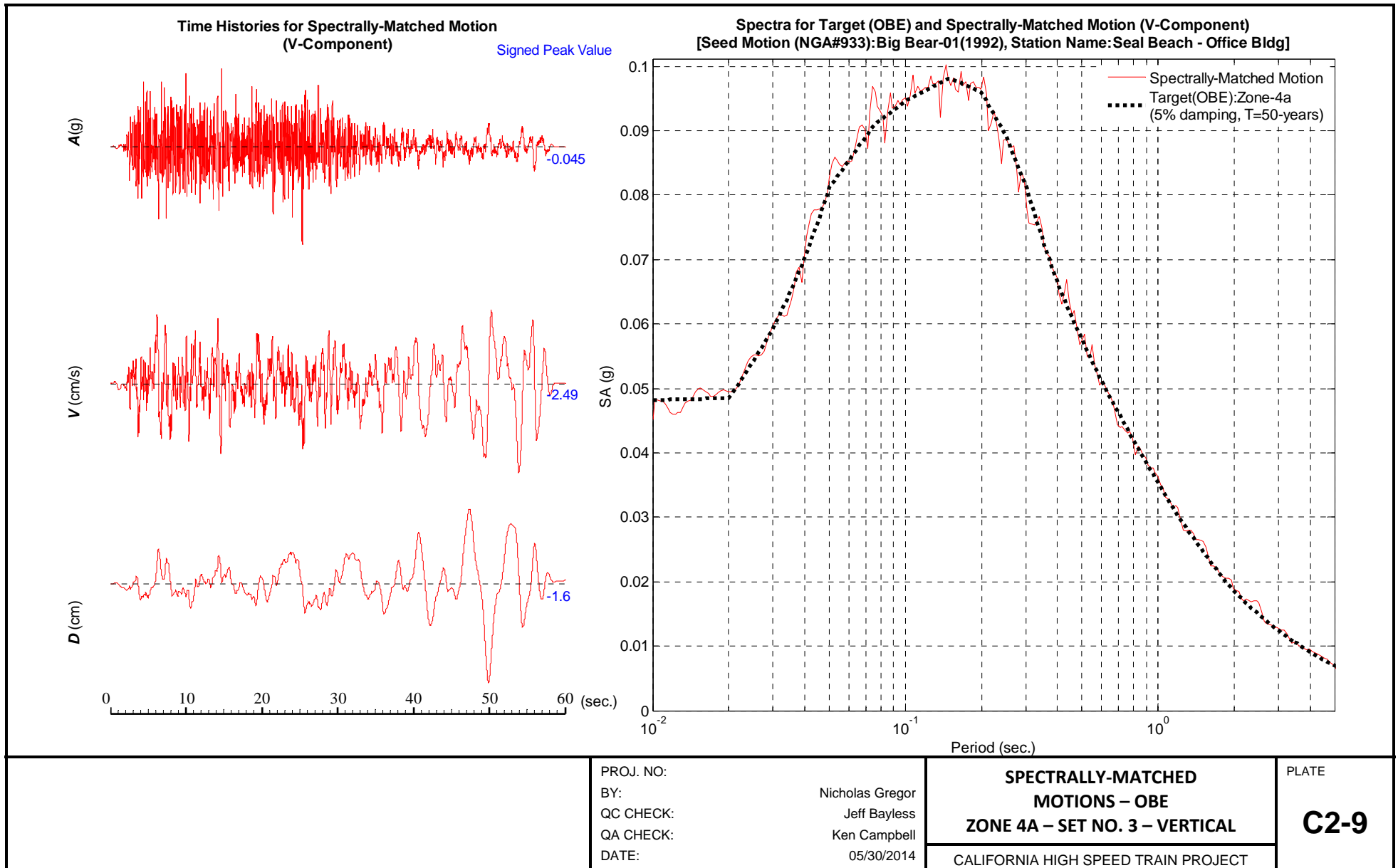




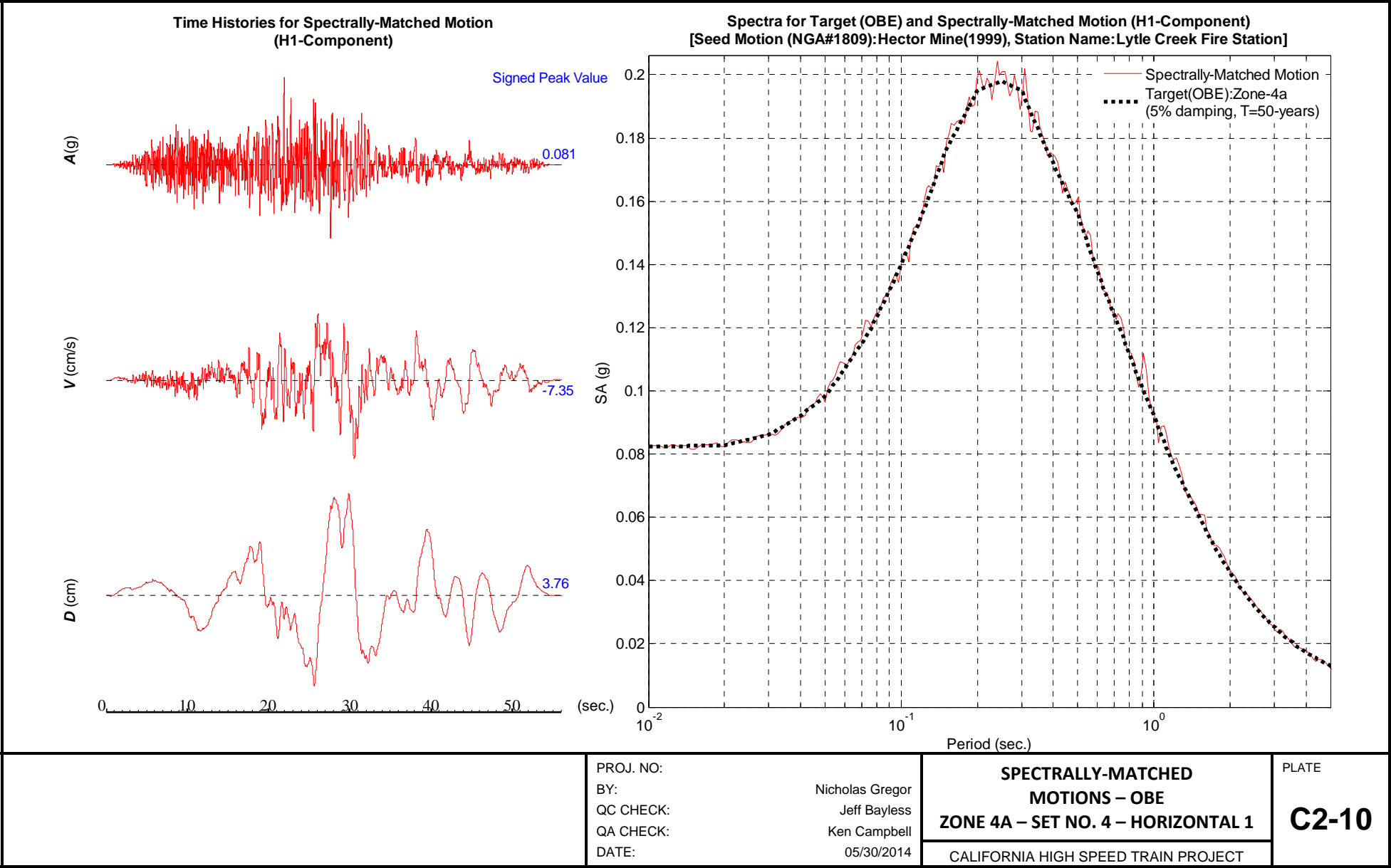


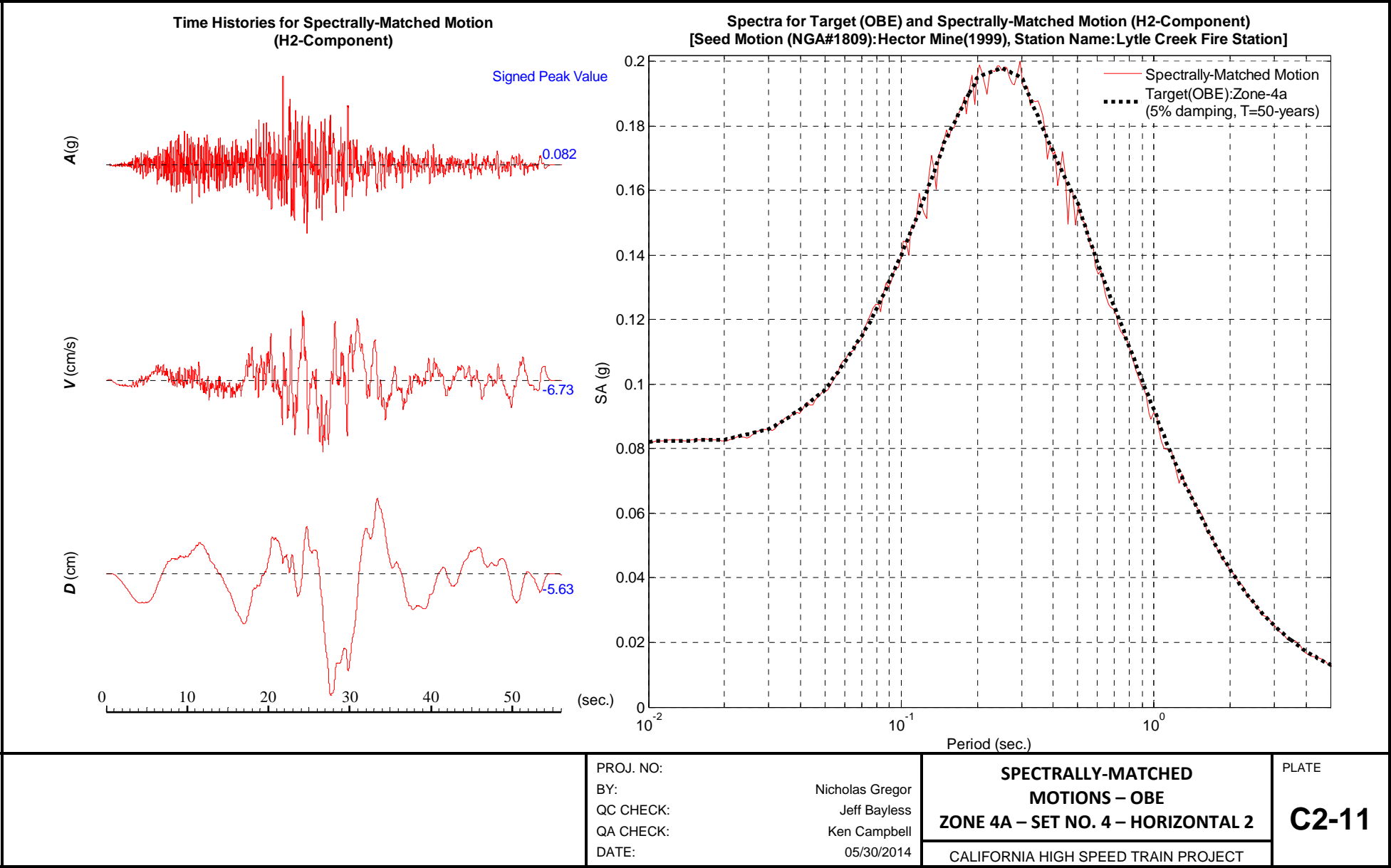




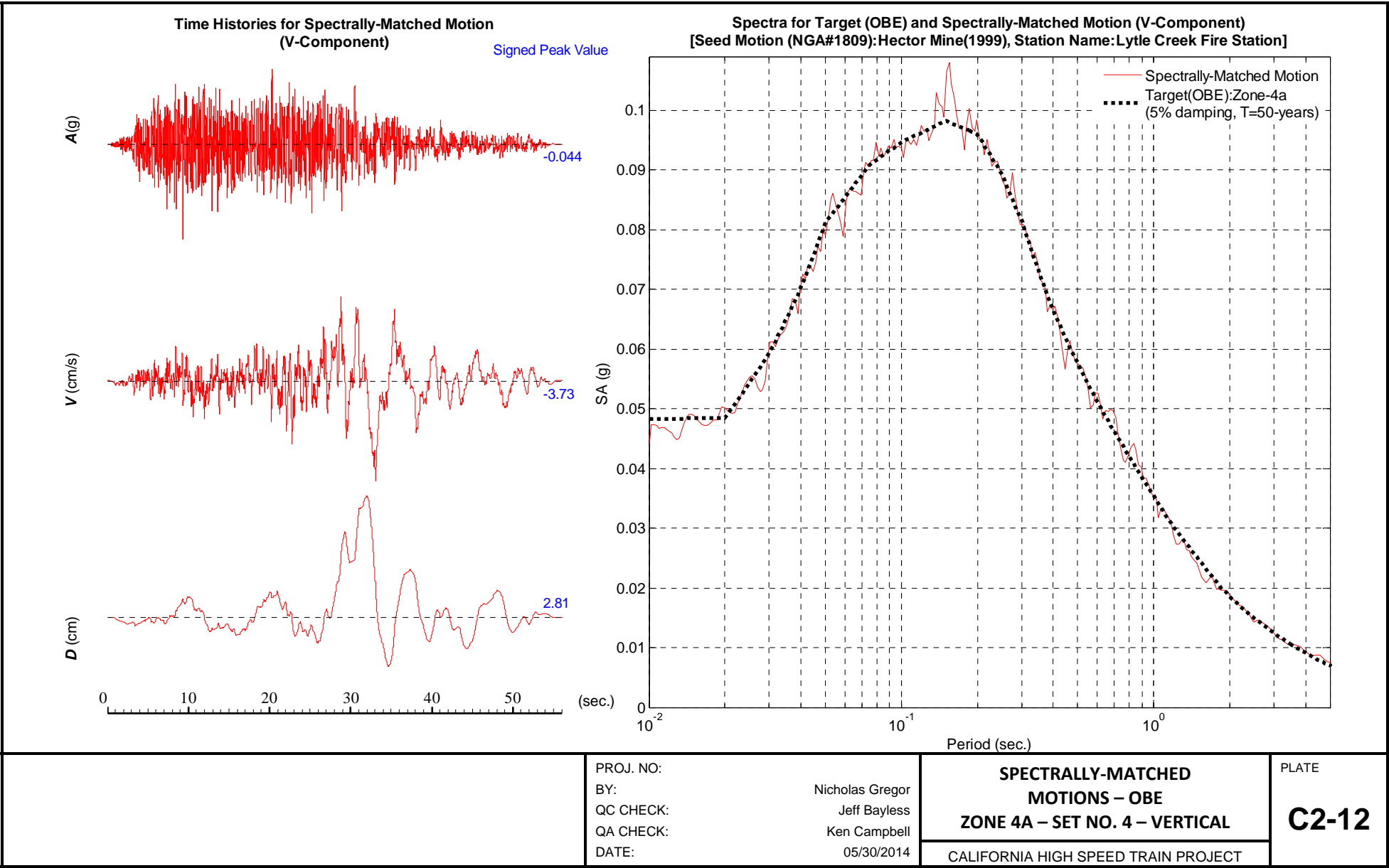




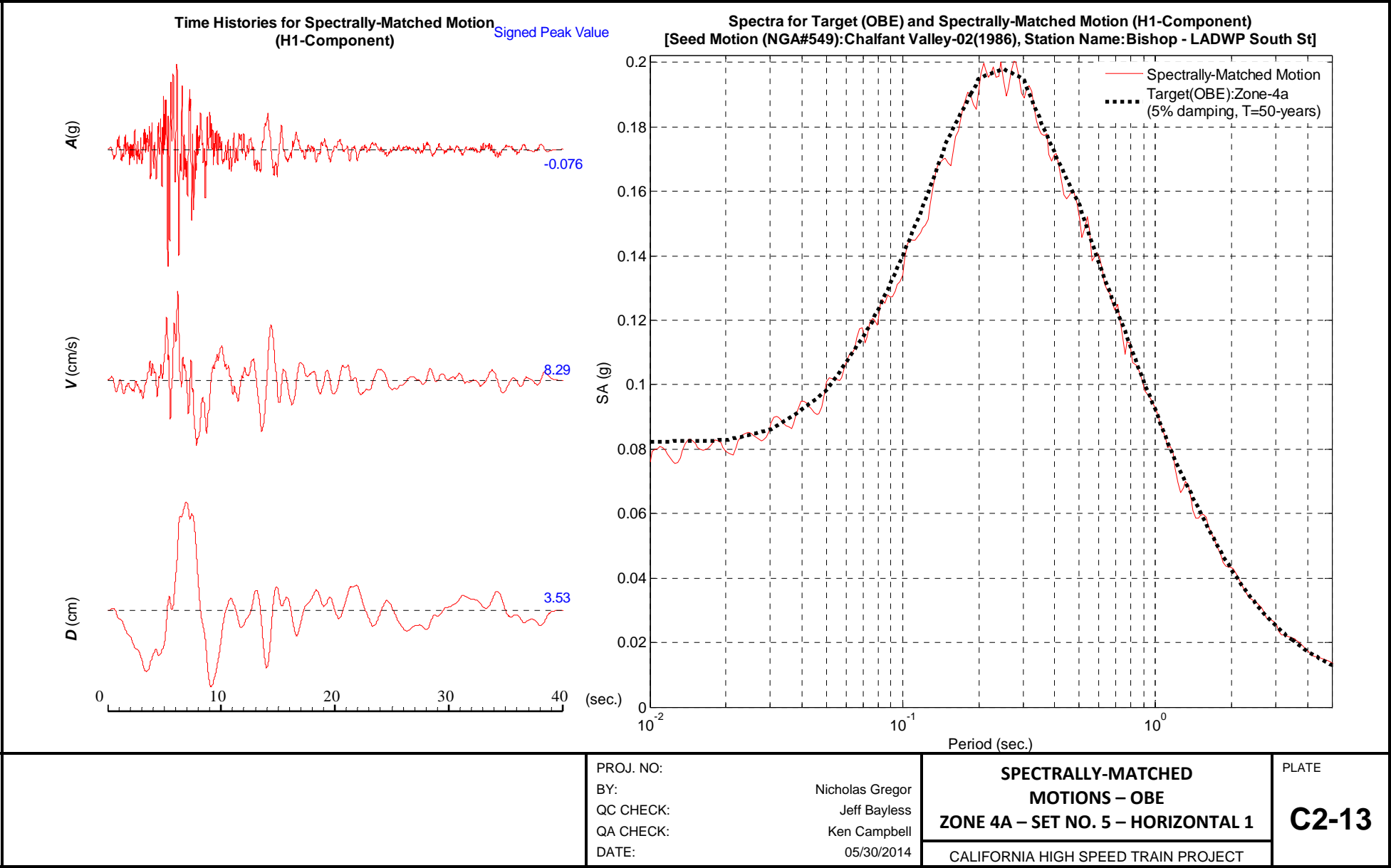




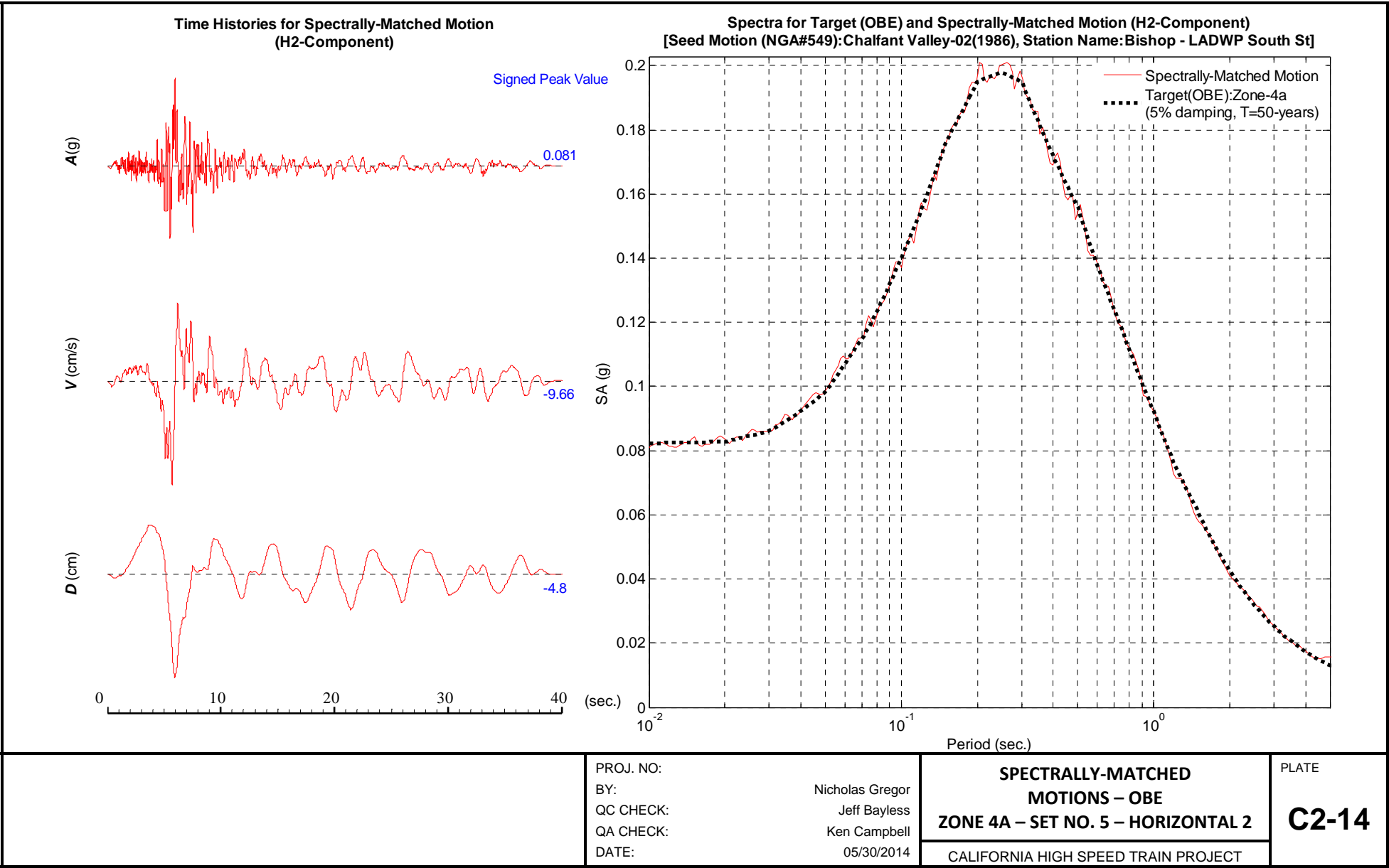
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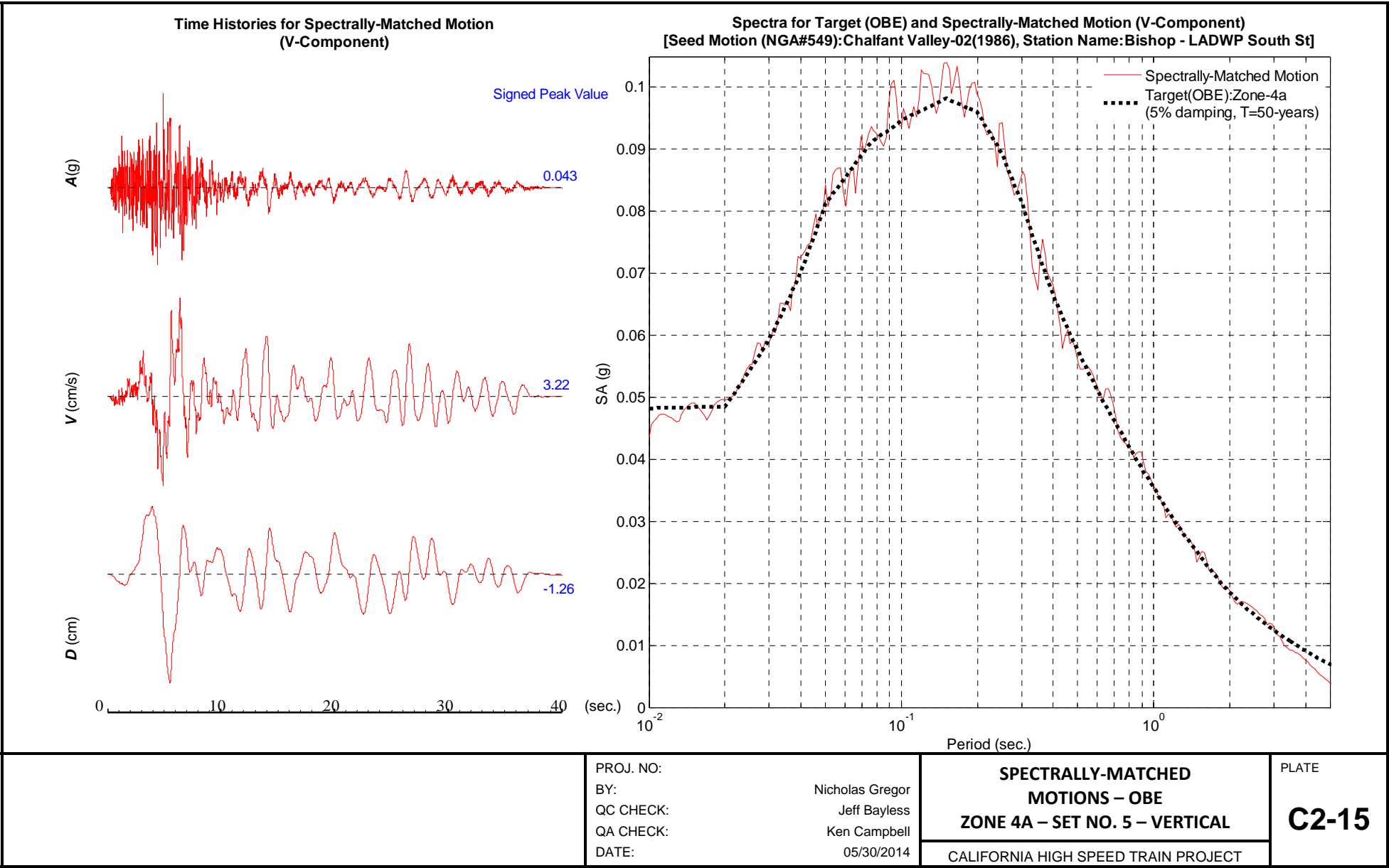


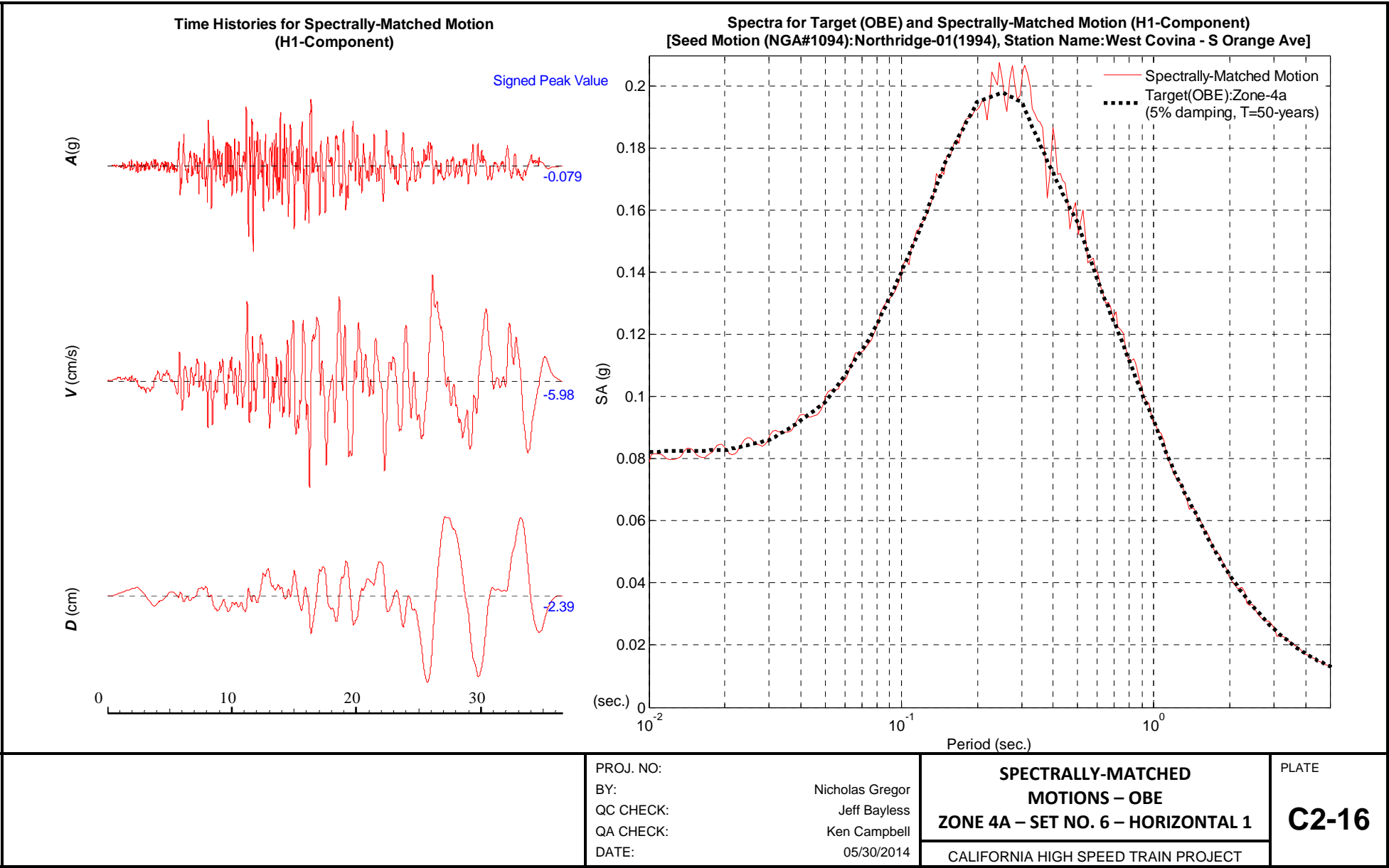
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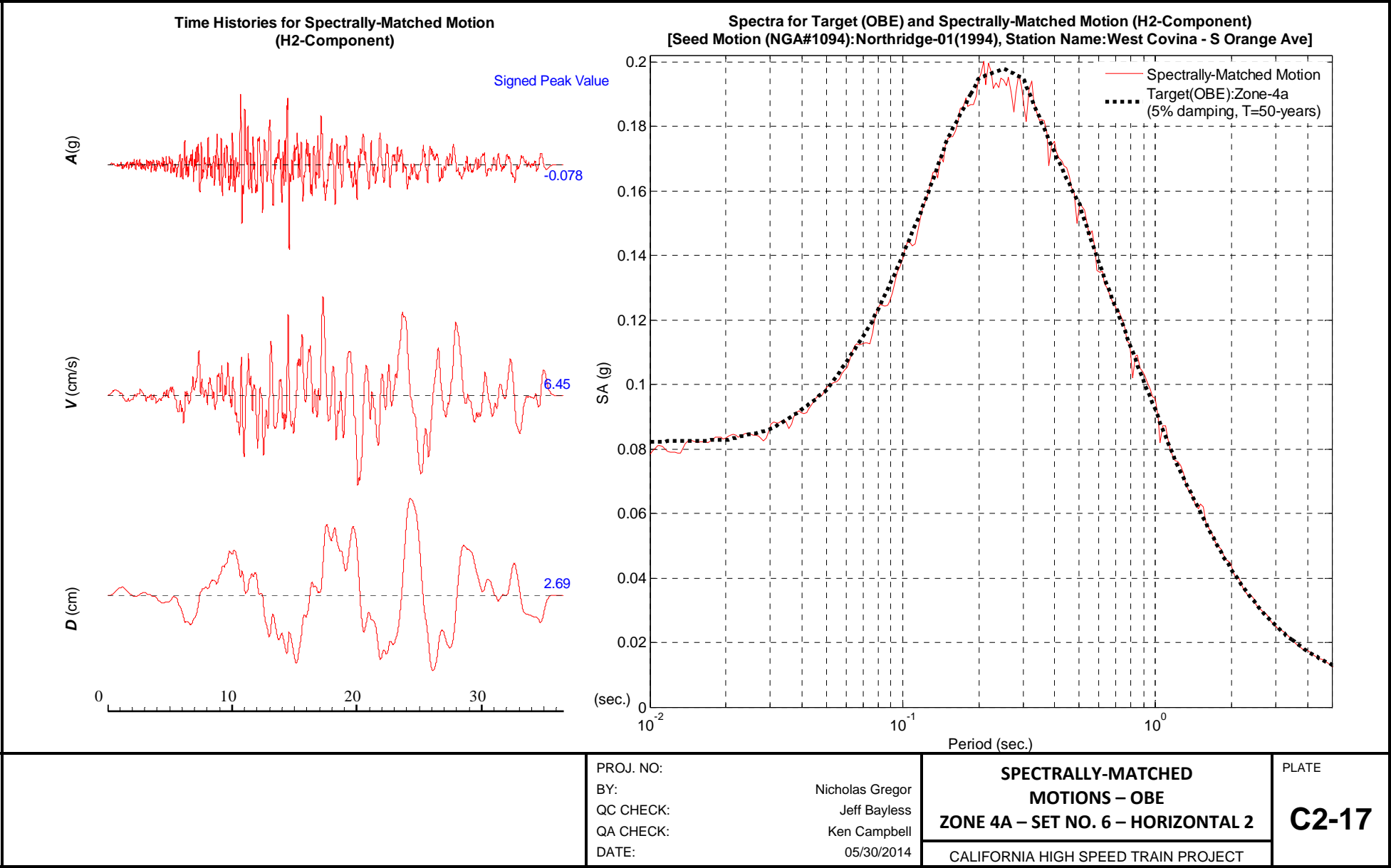


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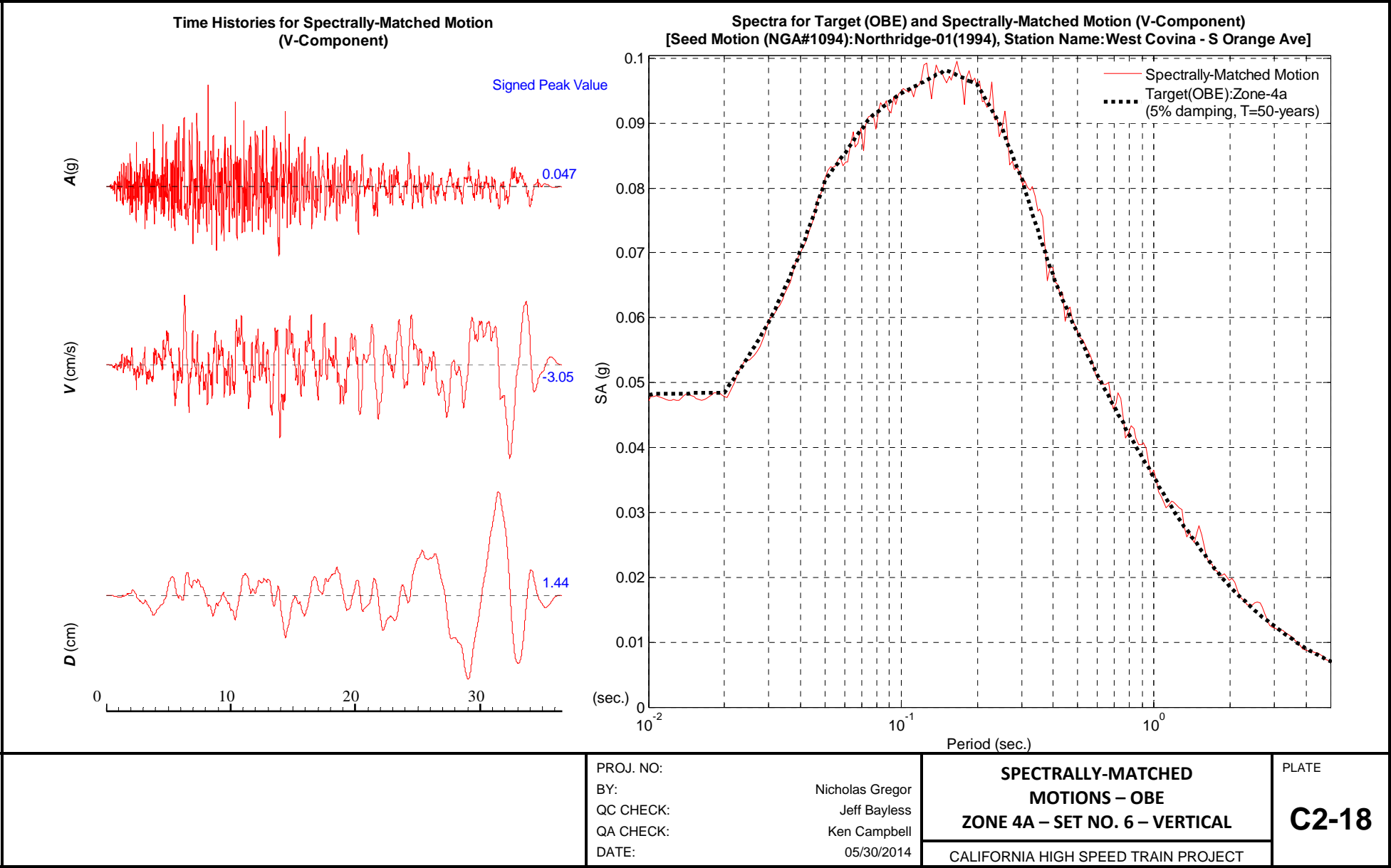




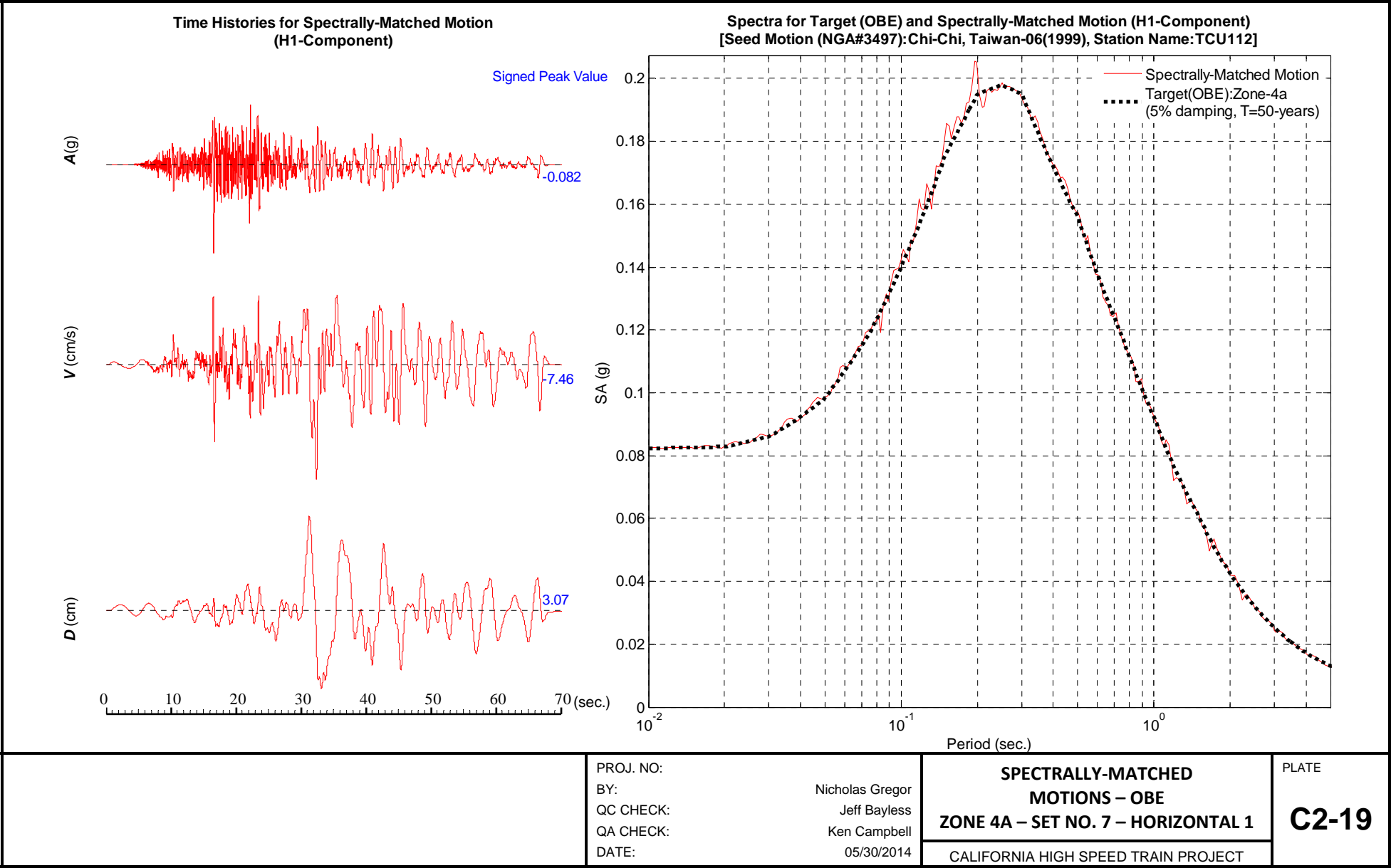




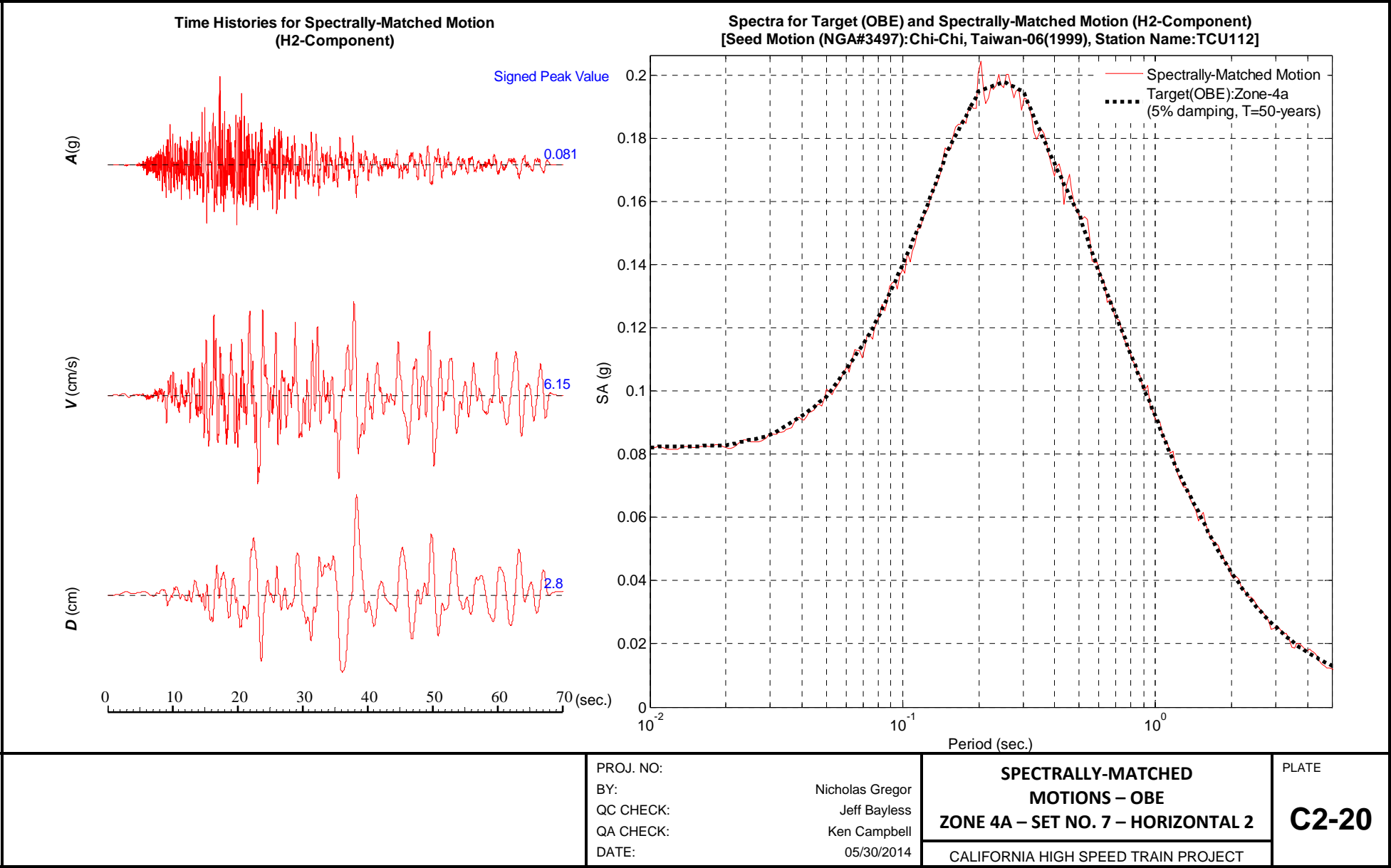


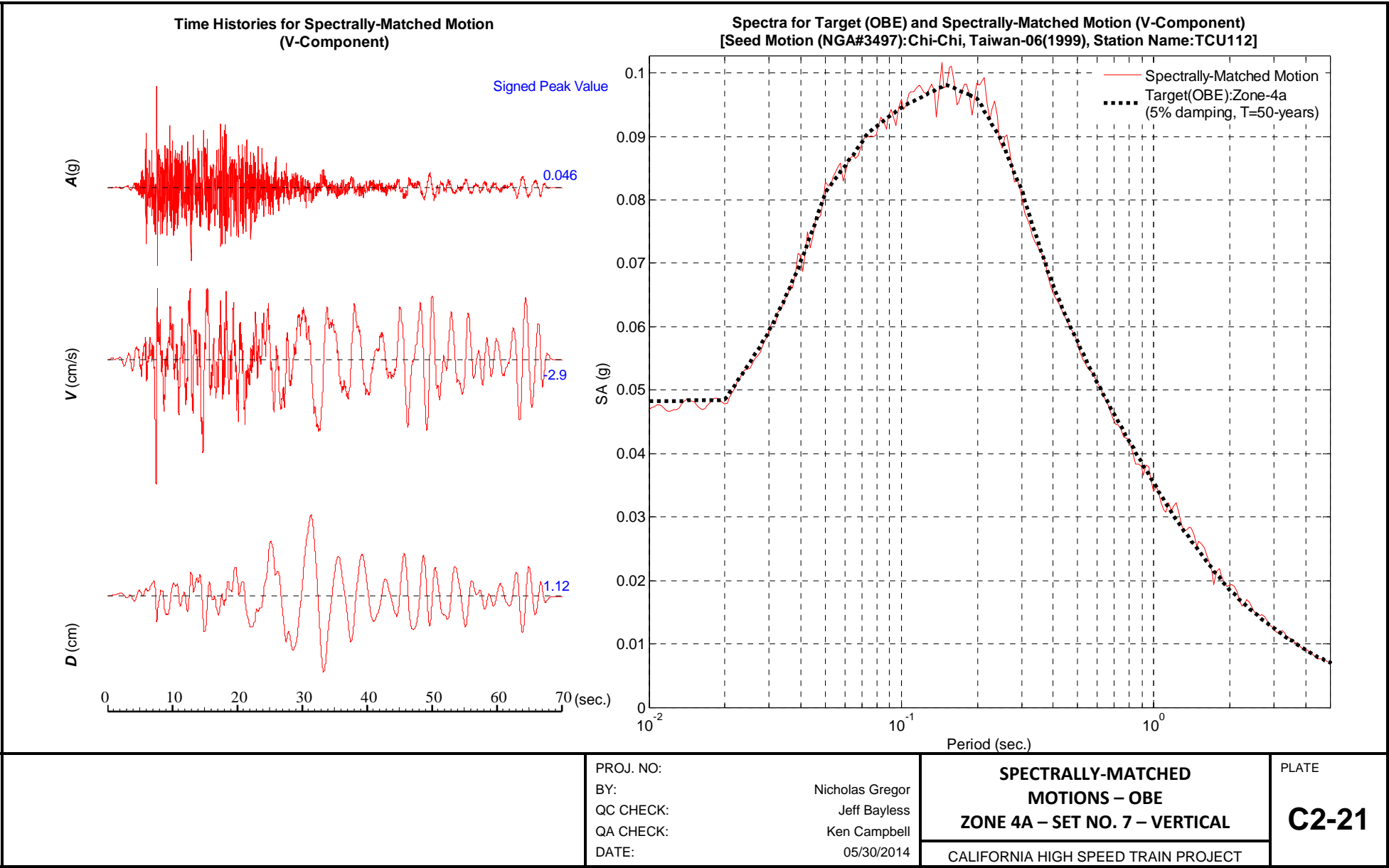


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RFP No.: 13-57 – Addendum No. 2 - 06/30/2014





RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

**Table C.4:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for Zone 4b**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA	PGV	PGD	PGA	PGV	PGD	PGA	PGV	PGD
							H1 (g)	H1 (cm/s)	H1 (cm)	H2 (g)	H2 (cm/s)	H2 (cm)	V (g)	V (cm/s)	V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.079	7.053	4.108	0.081	8.124	4.332	0.047	3.546	2.801
2	2776	Chi-Chi, Taiwan-04	1999	HWA028	6.20	92.39	0.080	8.466	2.791	0.080	6.886	2.157	0.046	3.119	1.181
3	933	Big Bear-01	1992	Seal Beach - Office Bldg	6.46	126.22	0.082	8.802	3.222	0.080	7.788	2.837	0.046	2.407	1.604
4	1809	Hector Mine	1999	Lytle Creek Fire Station	7.13	112.26	0.081	7.293	3.693	0.083	6.816	4.966	0.046	3.732	2.355
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.077	8.364	3.553	0.081	9.689	4.788	0.045	3.453	1.459
6	176	Imperial Valley-06	1979	El Centro Array #13	6.53	21.98	0.082	7.445	4.771	0.082	8.439	3.198	0.047	3.493	1.480
7	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.080	6.208	2.406	0.078	6.346	2.689	0.047	3.023	1.517

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QA CHECK:

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Nicholas Gregor

Jeff Bayless

Ken Campbell

05/30/2014

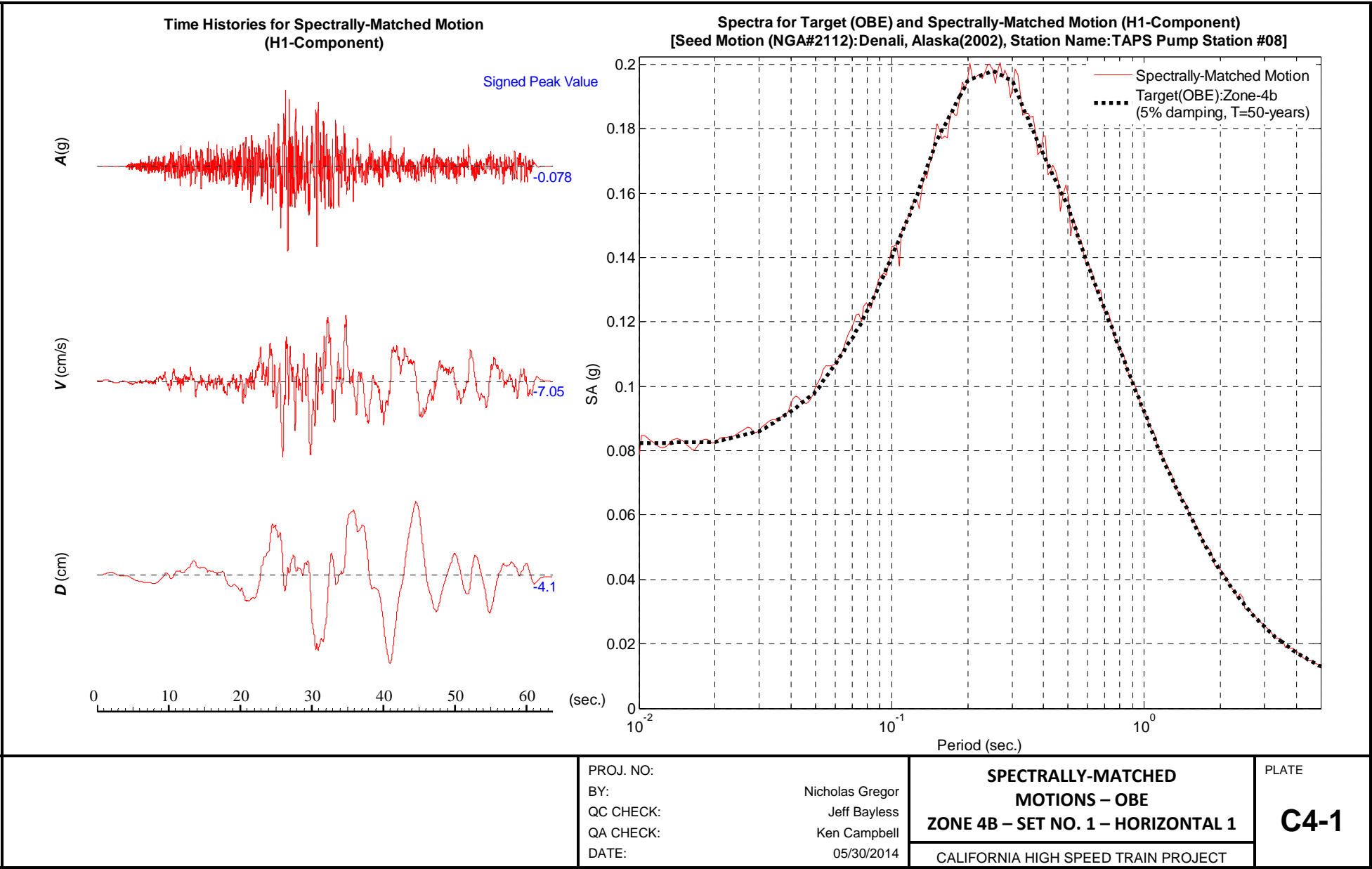
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
OBE – ZONE 4B**

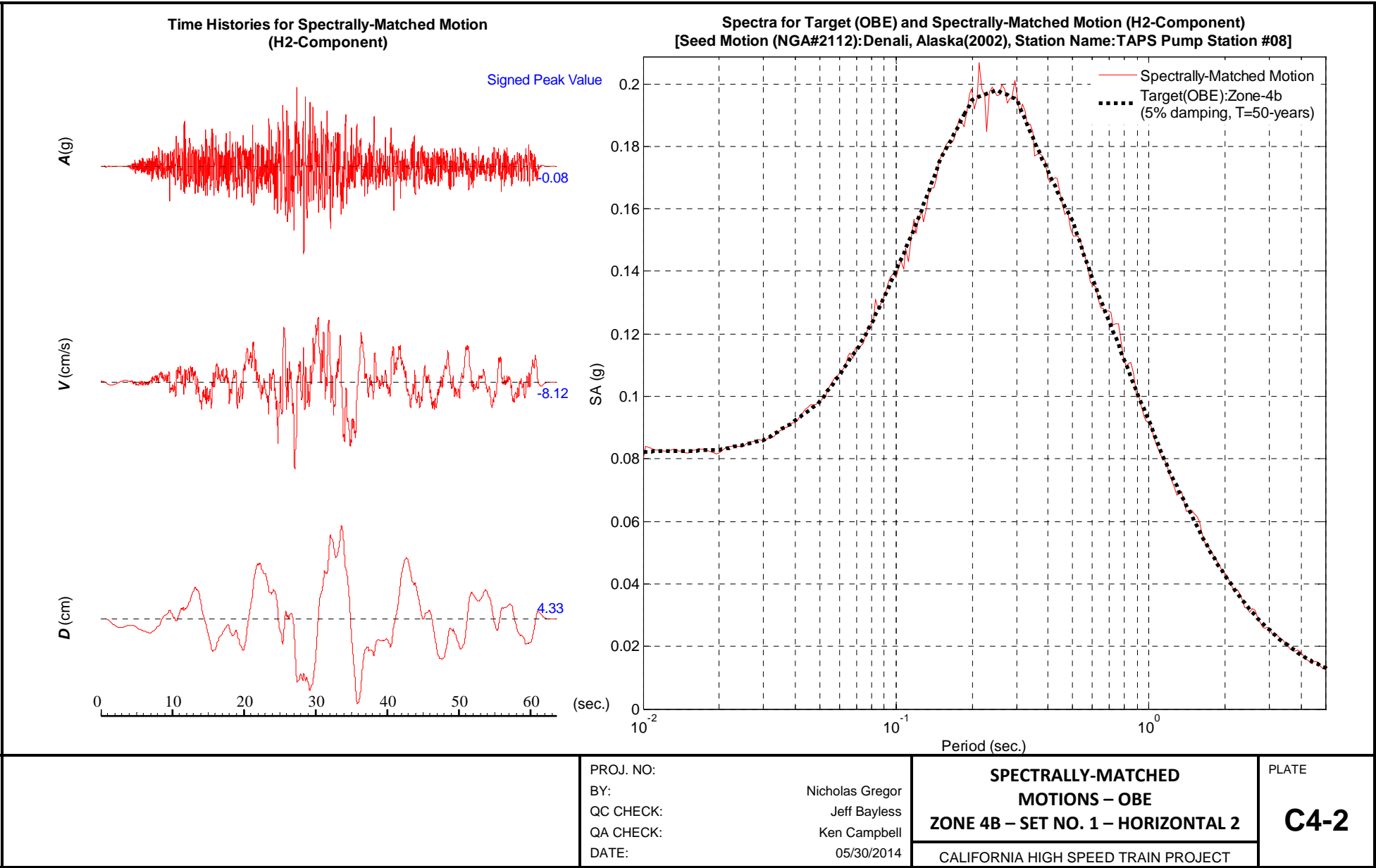
CALIFORNIA HIGH SPEED TRAIN PROJECT

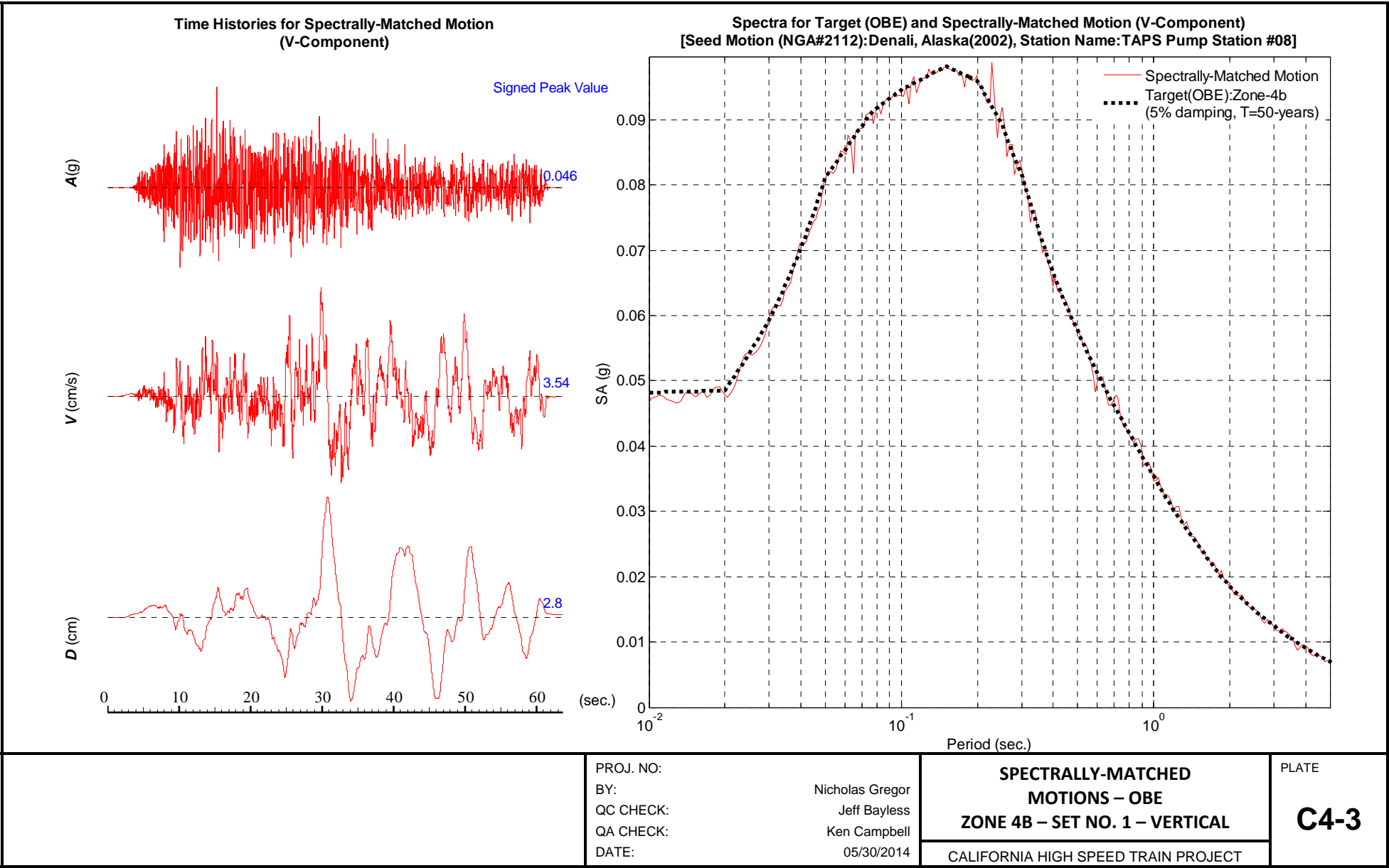
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**C4-0**

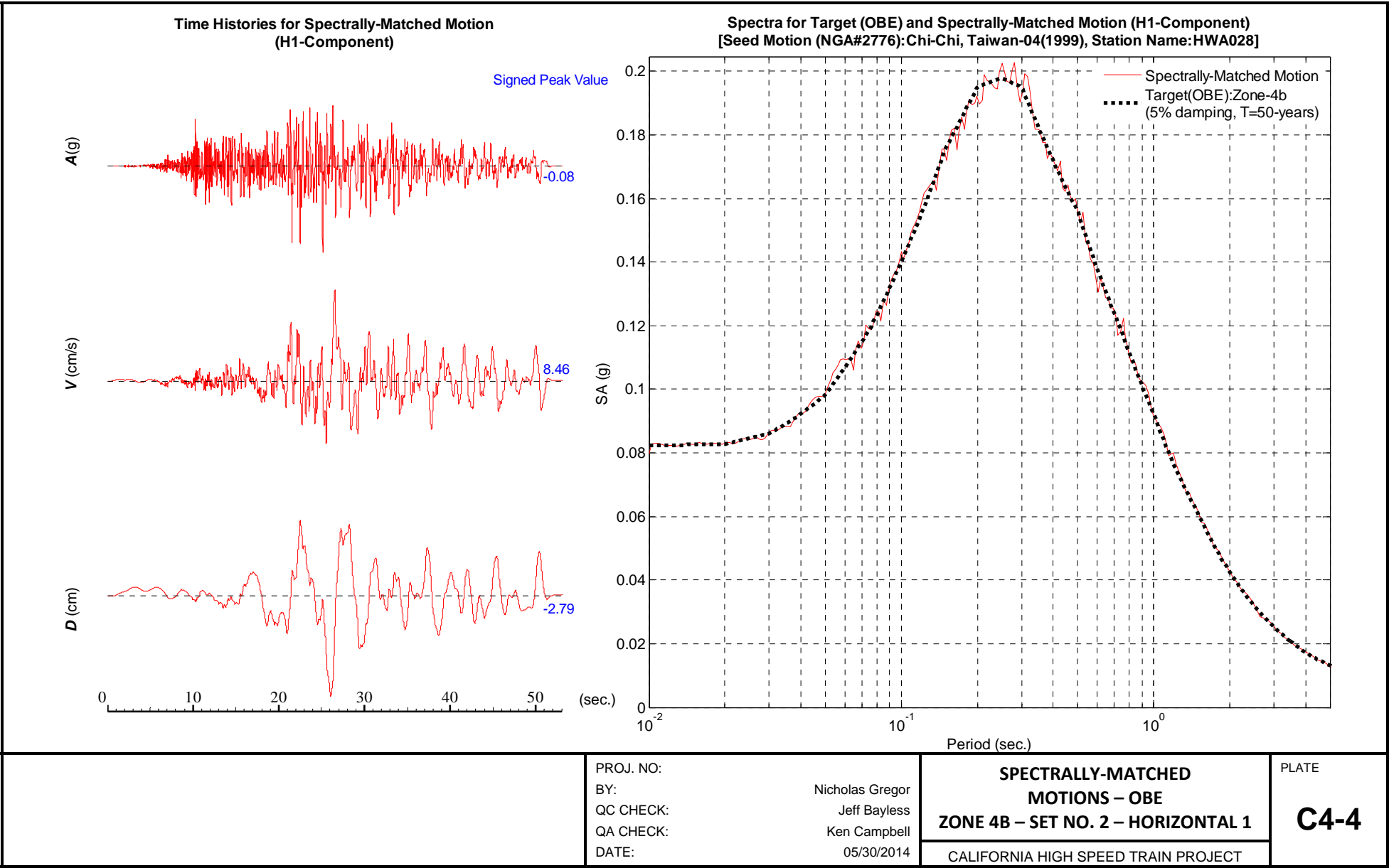
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



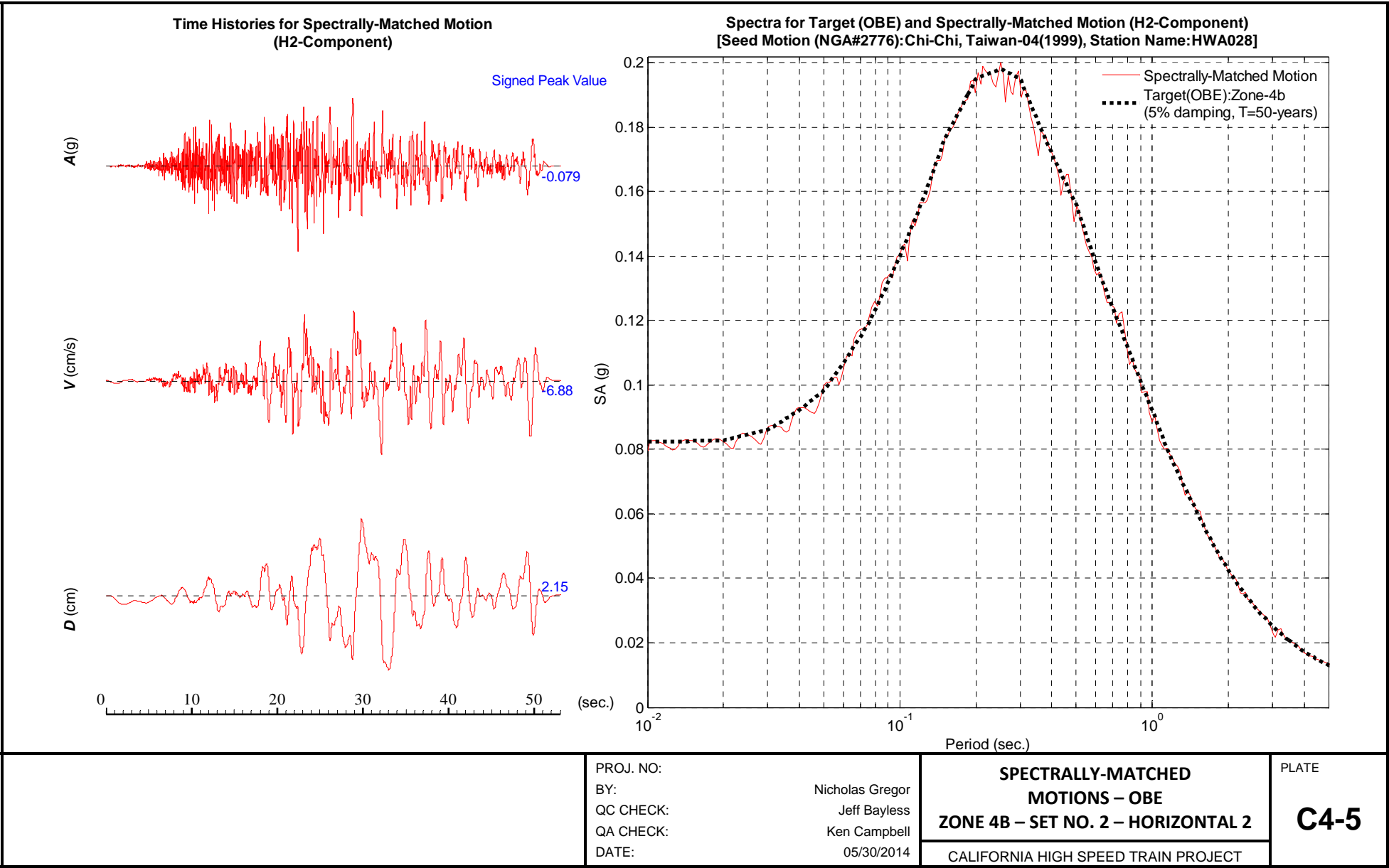


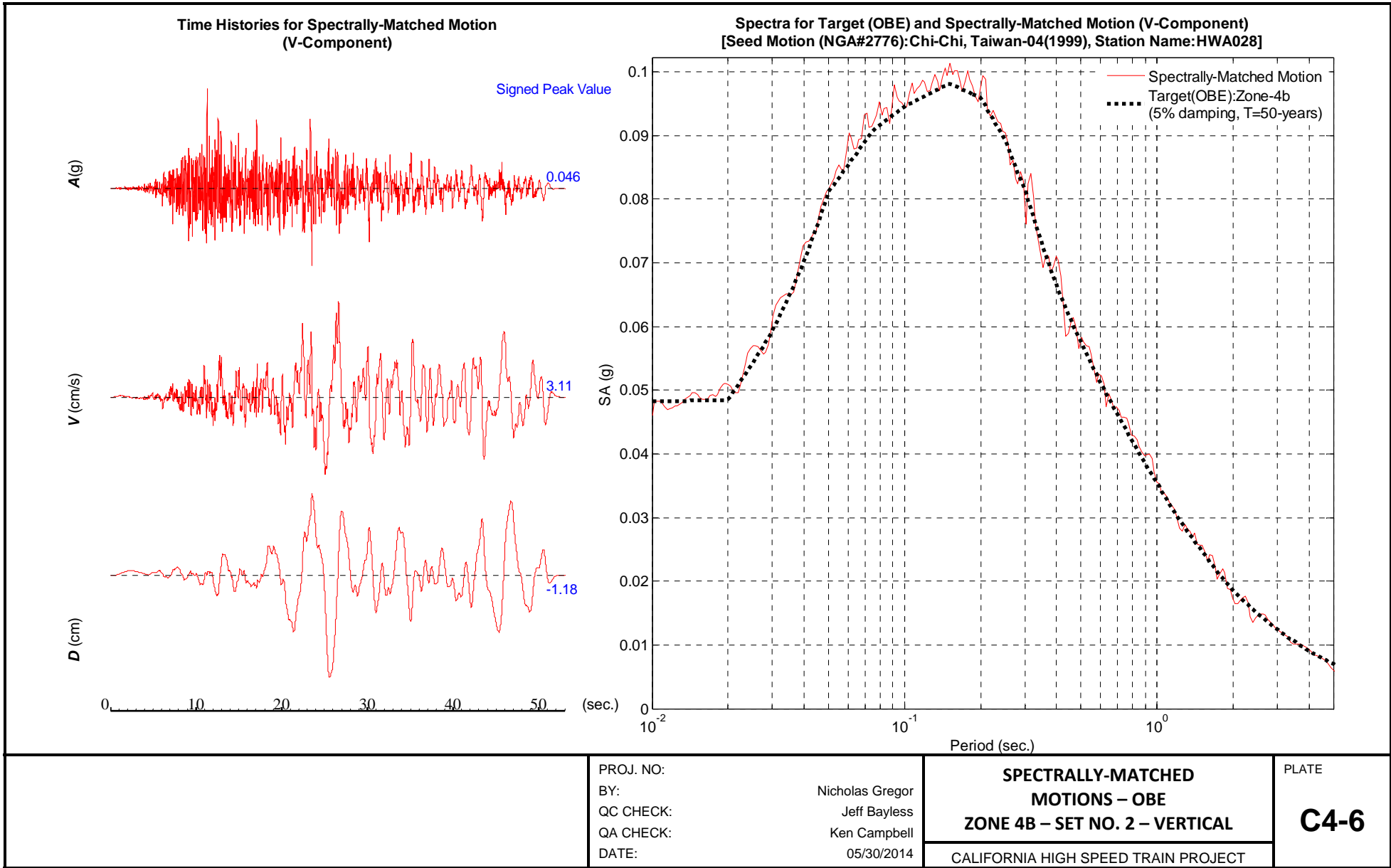


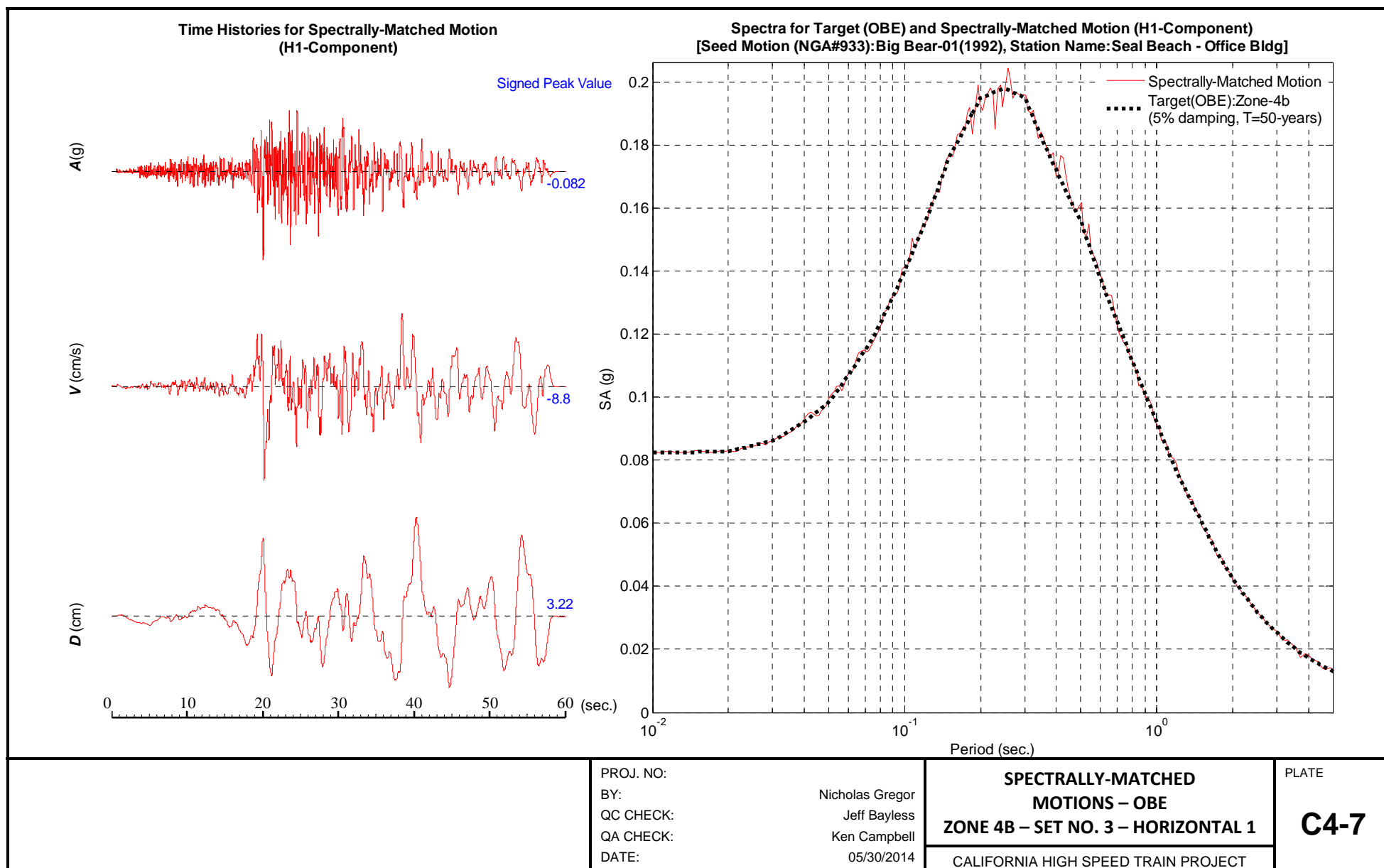


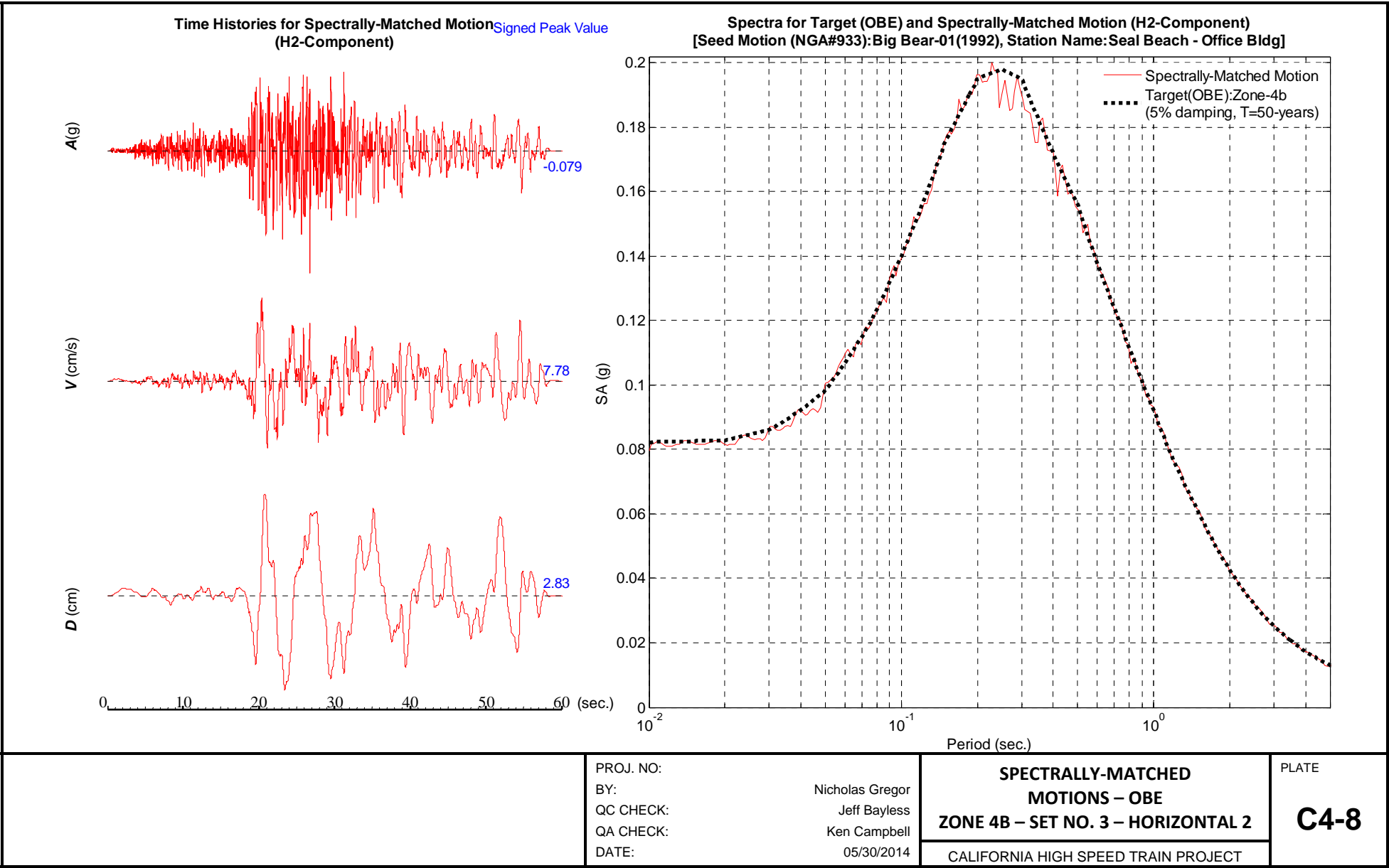


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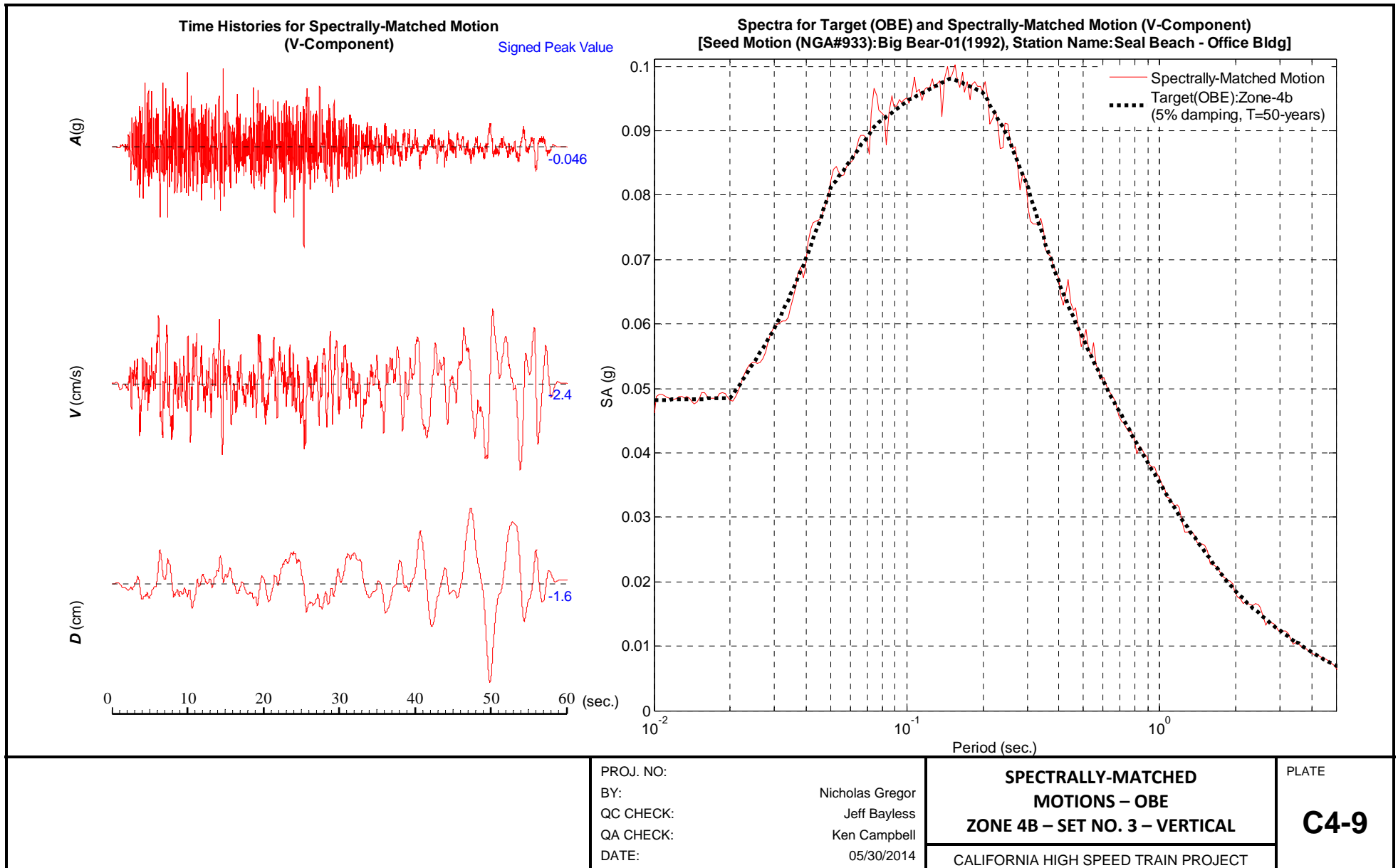


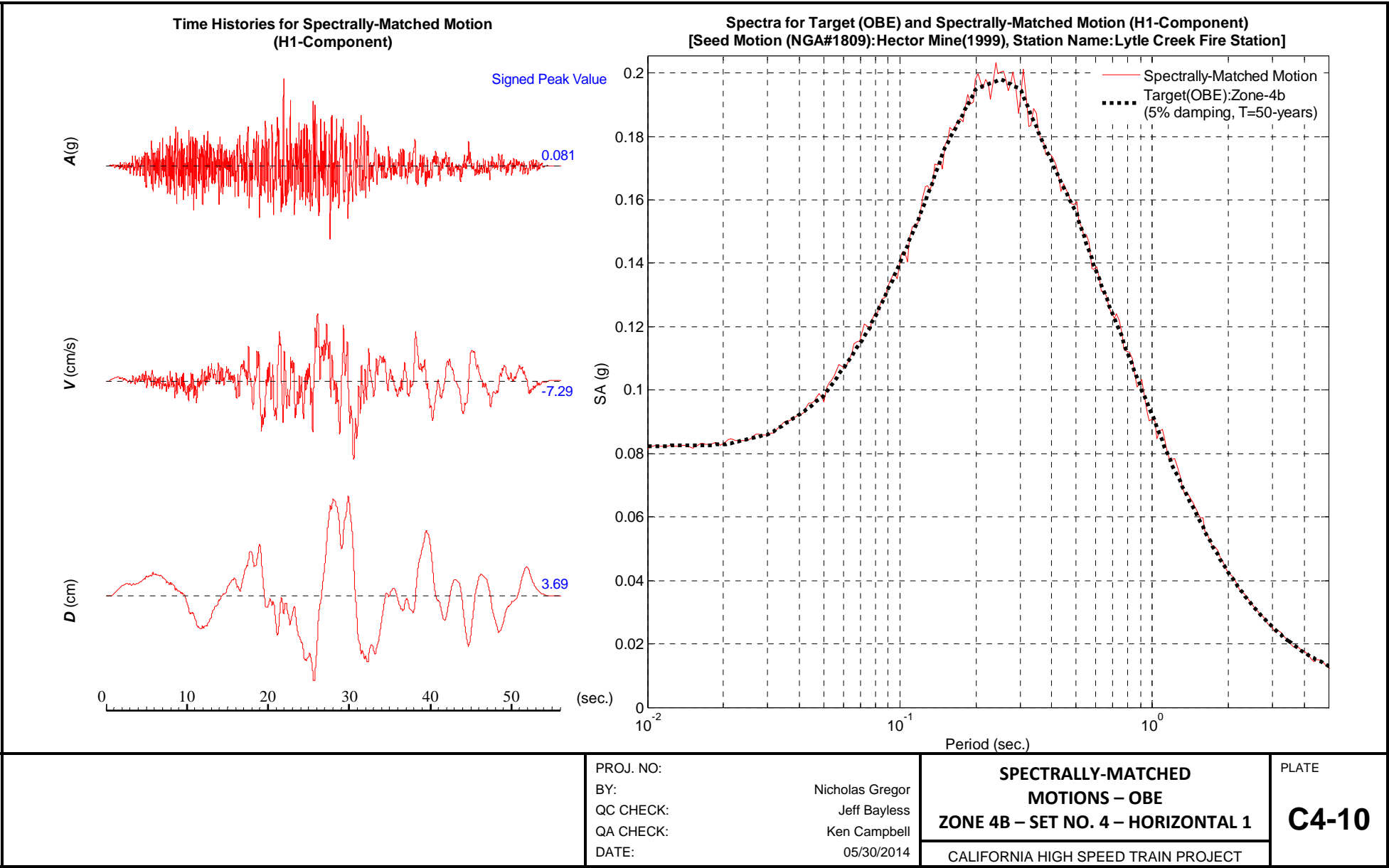


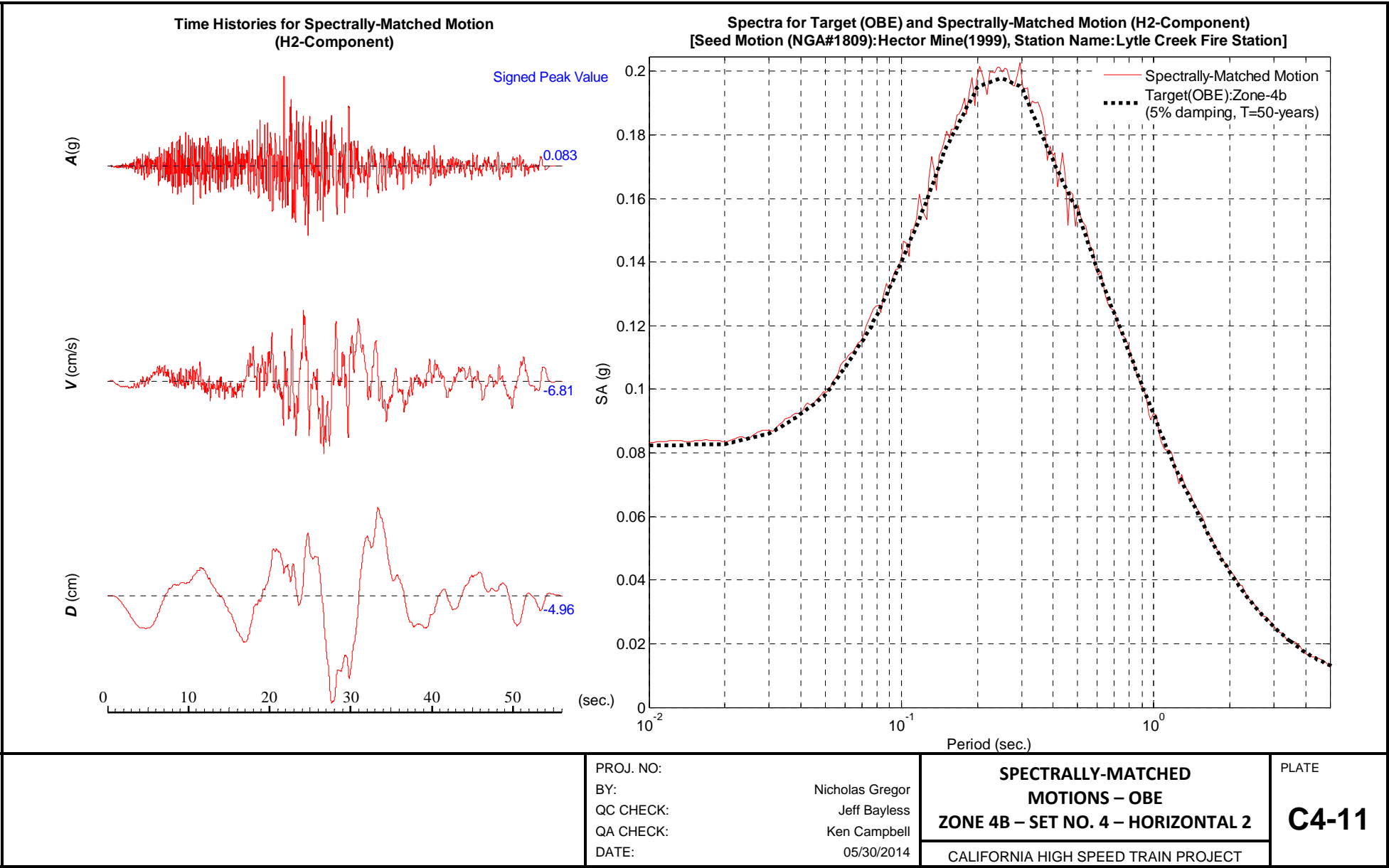




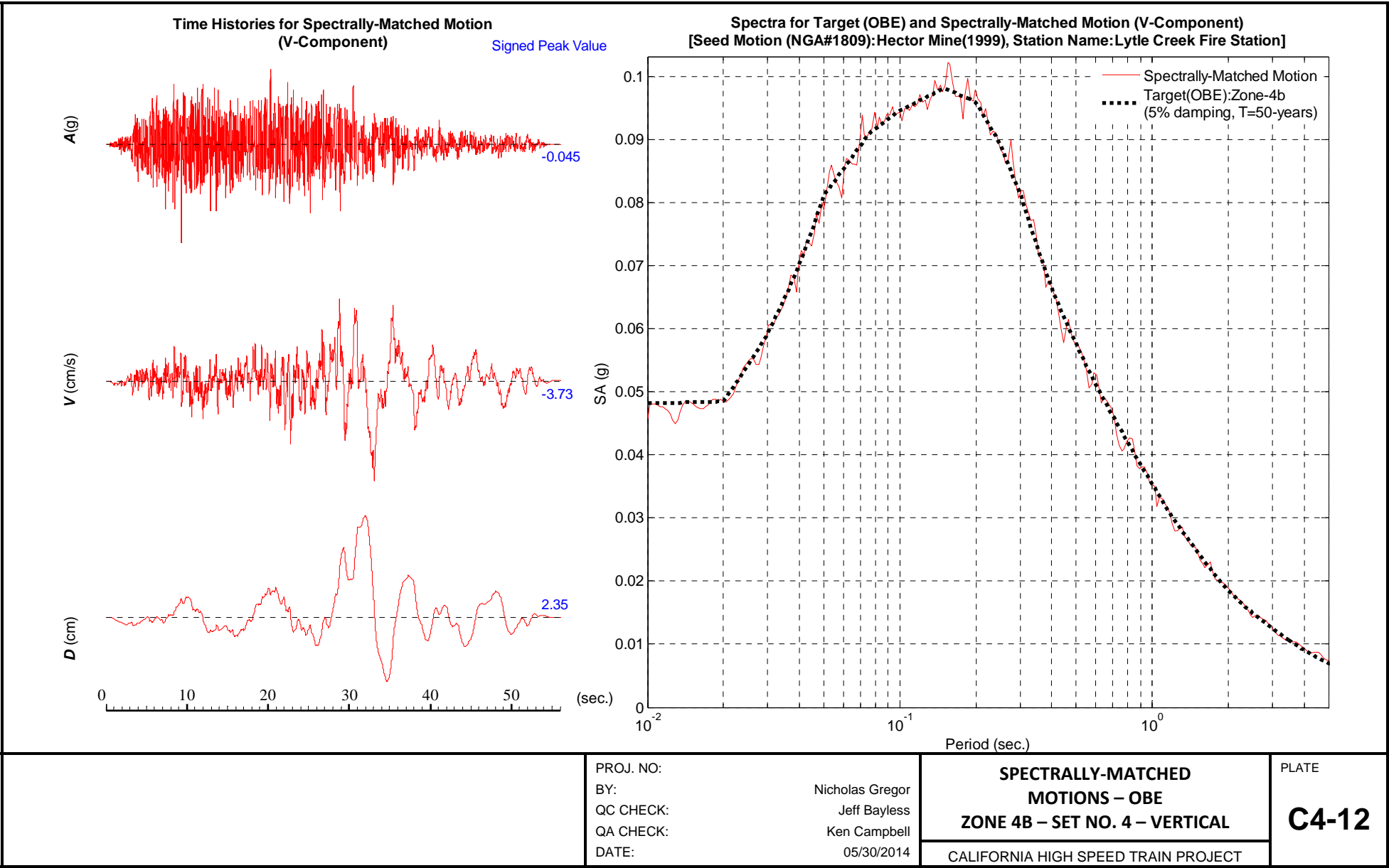
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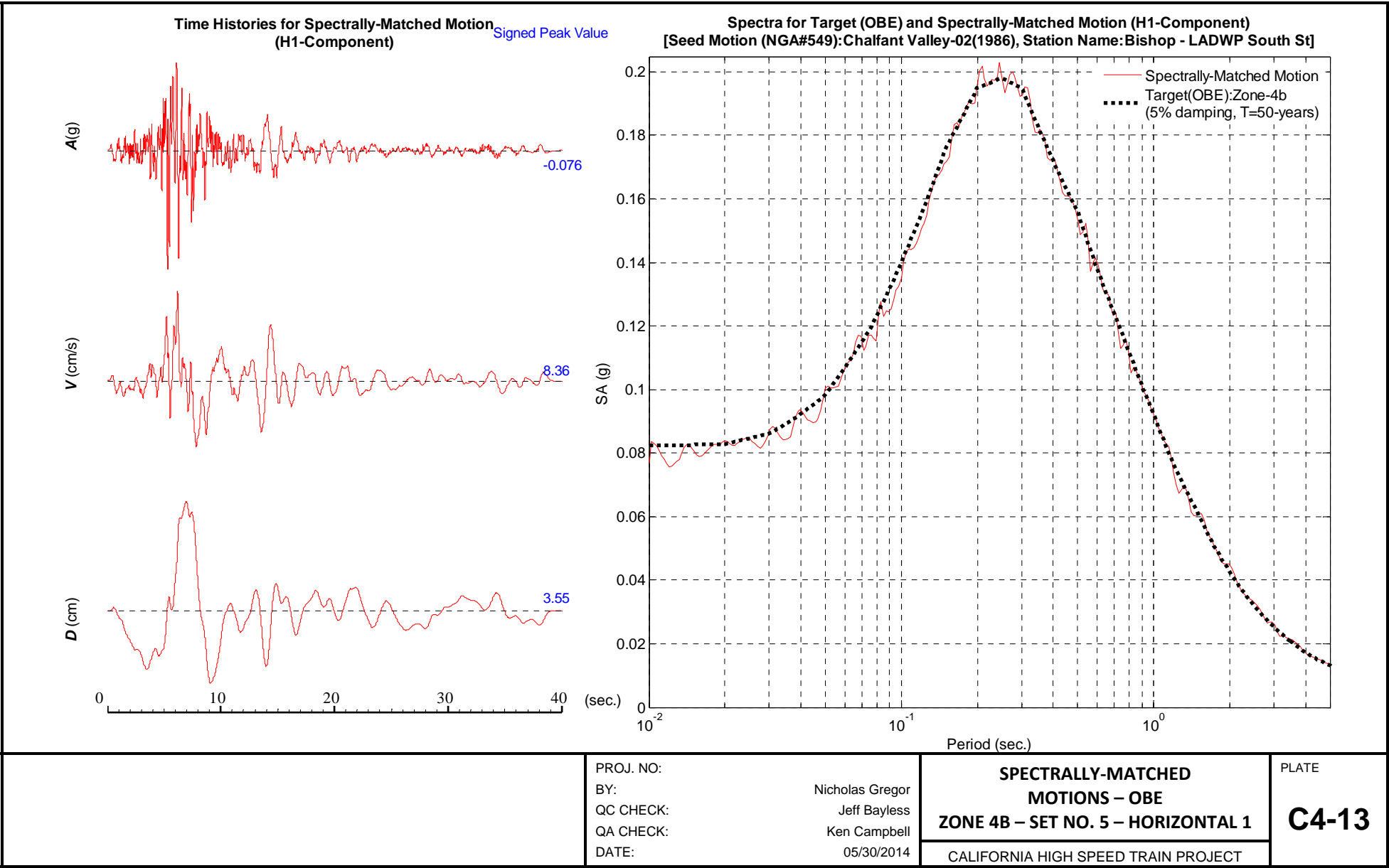


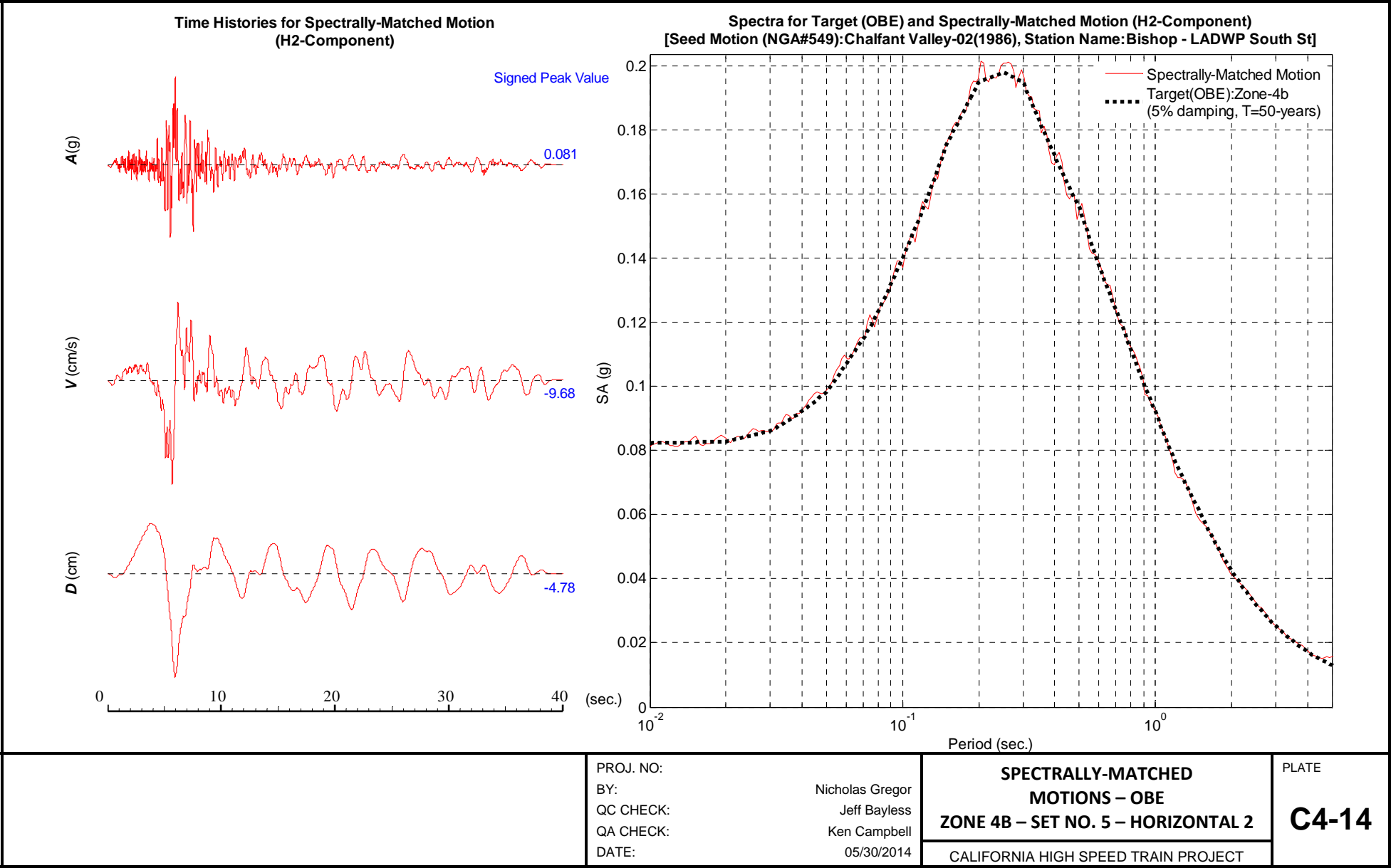


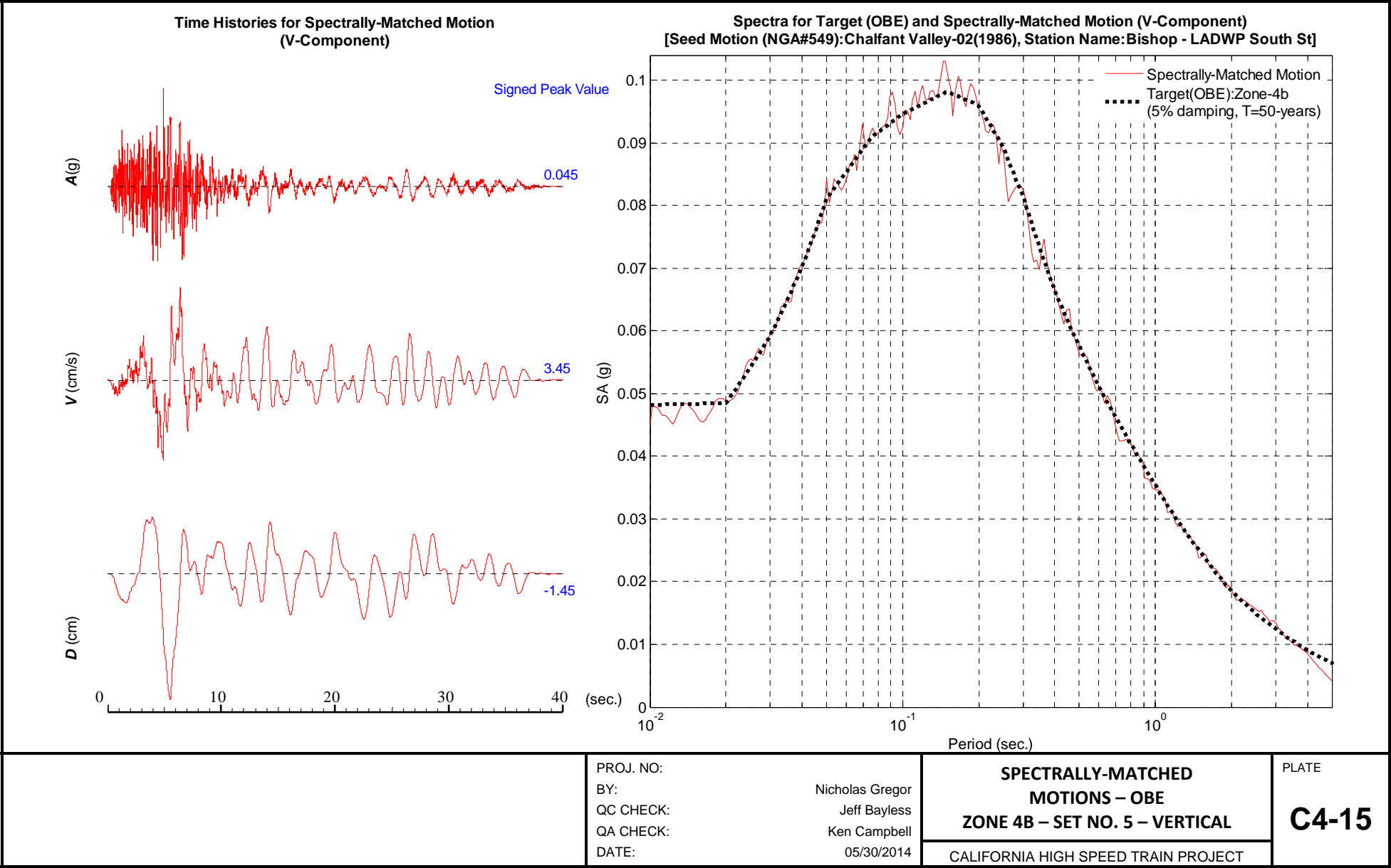


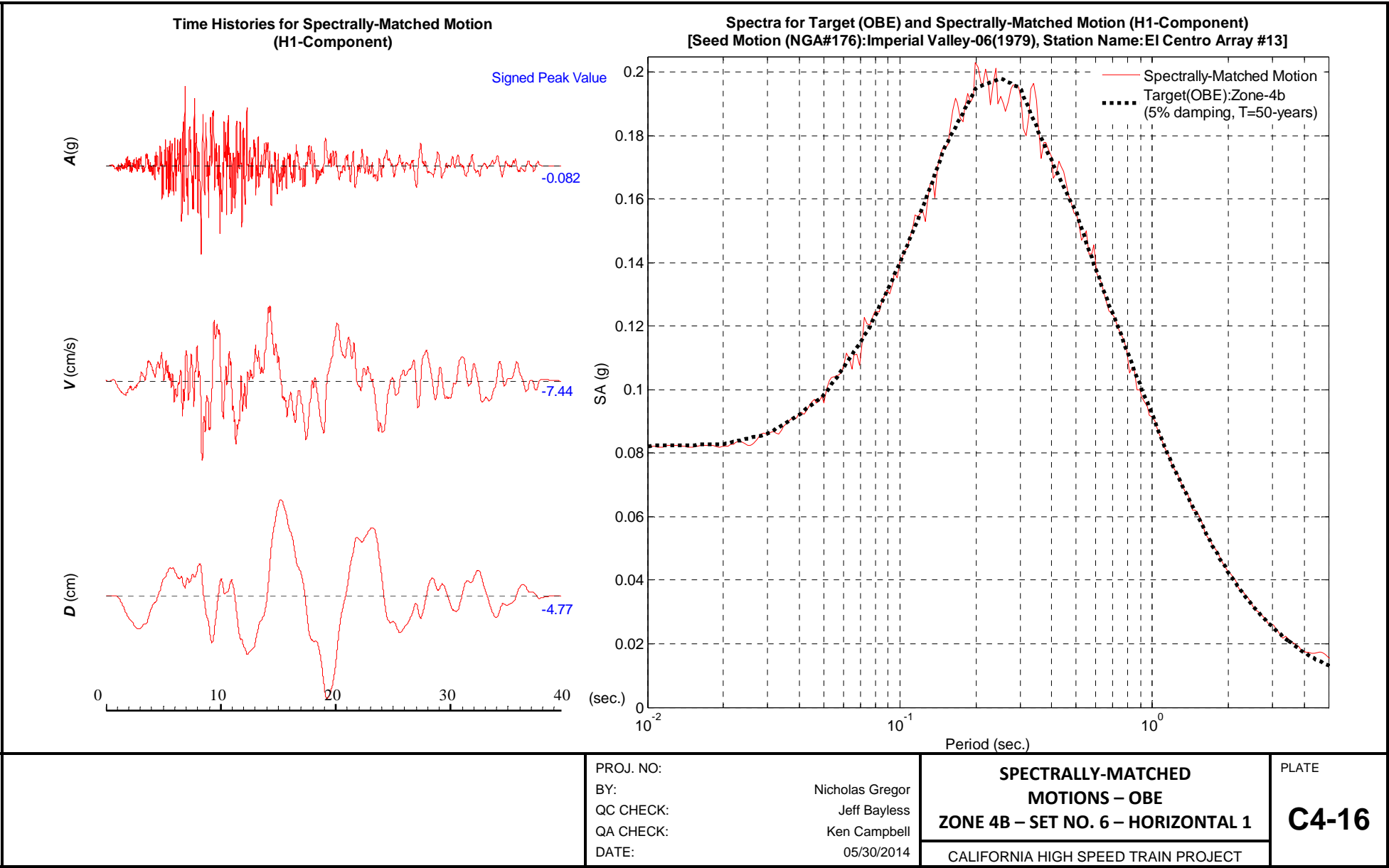


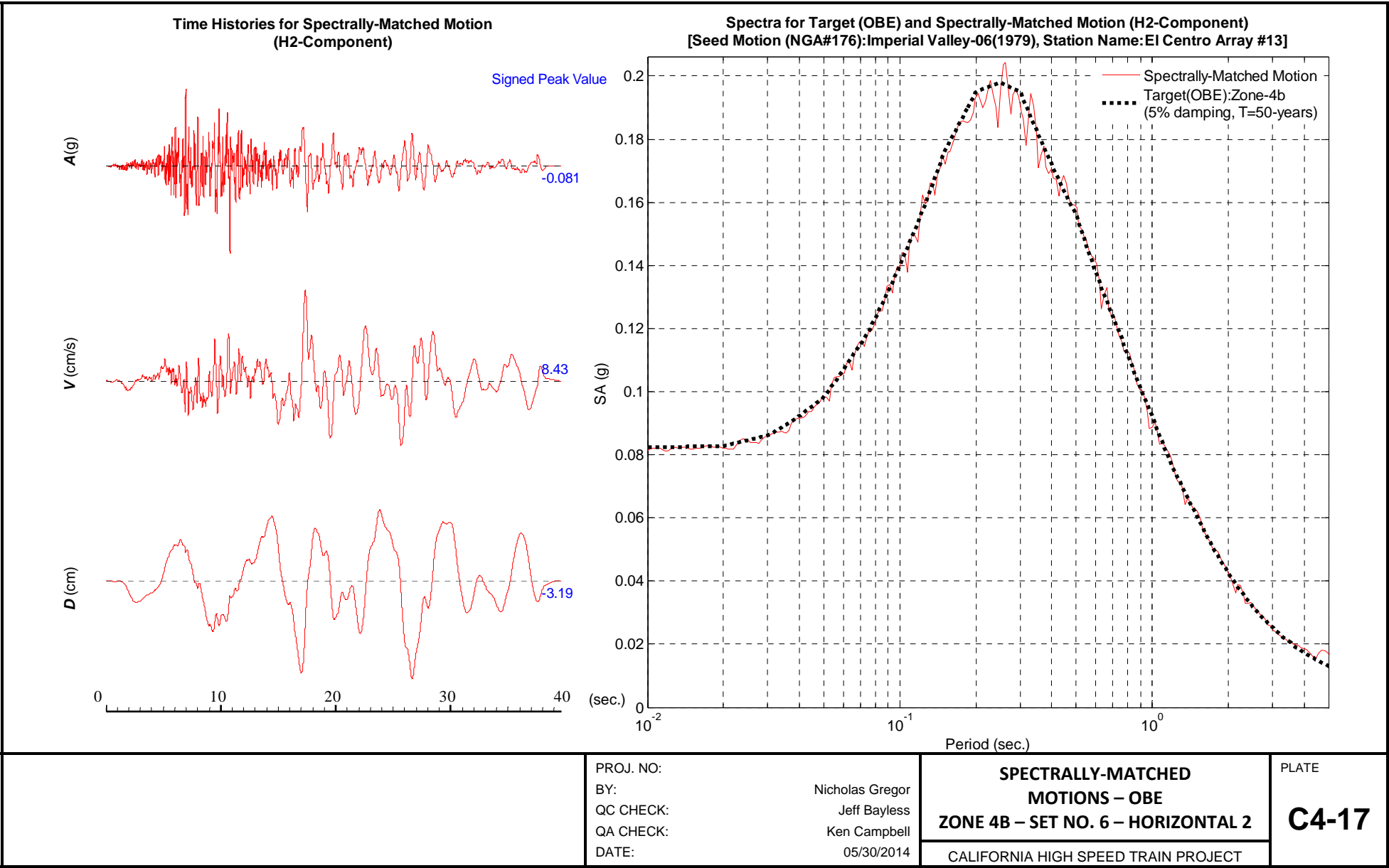
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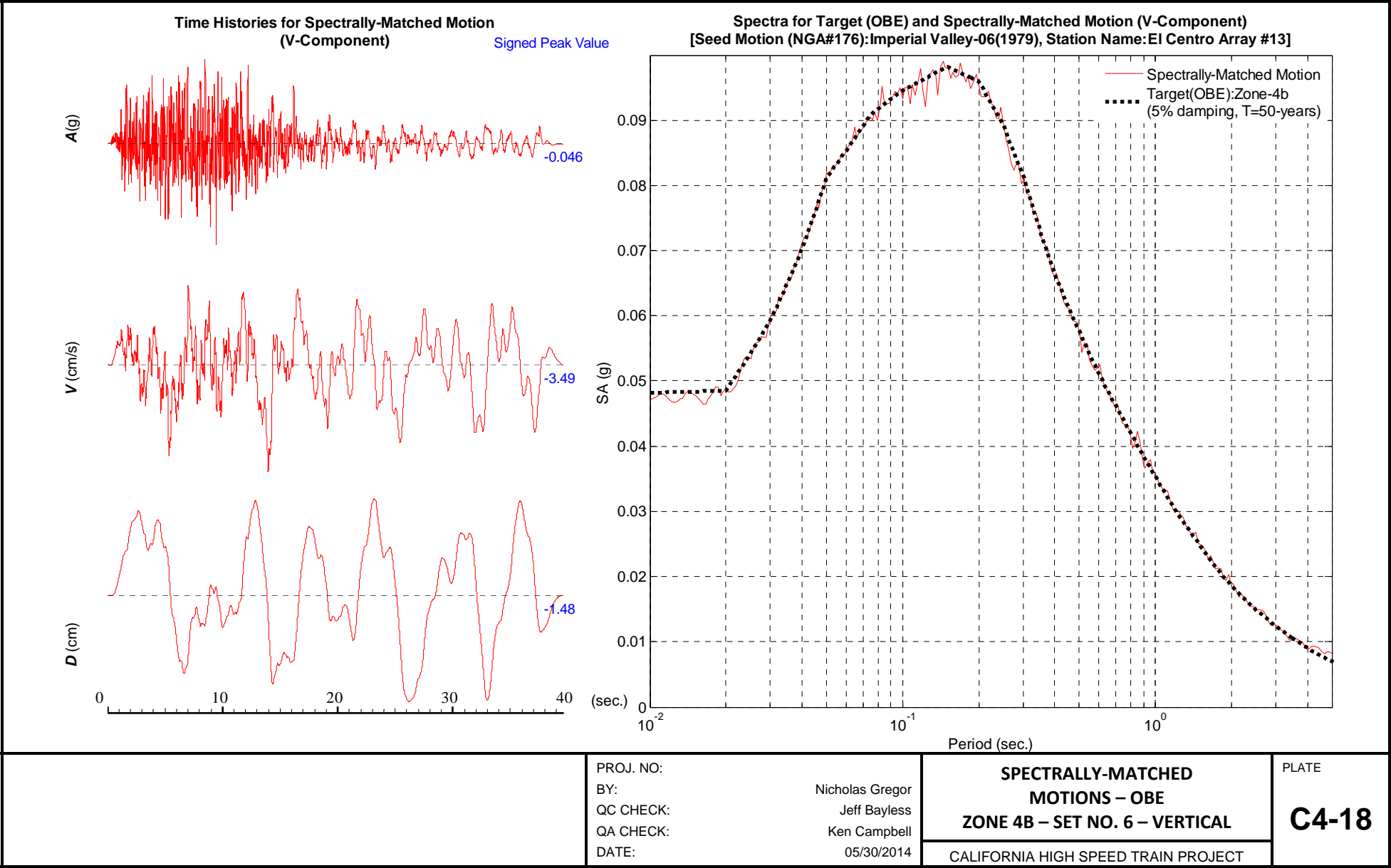




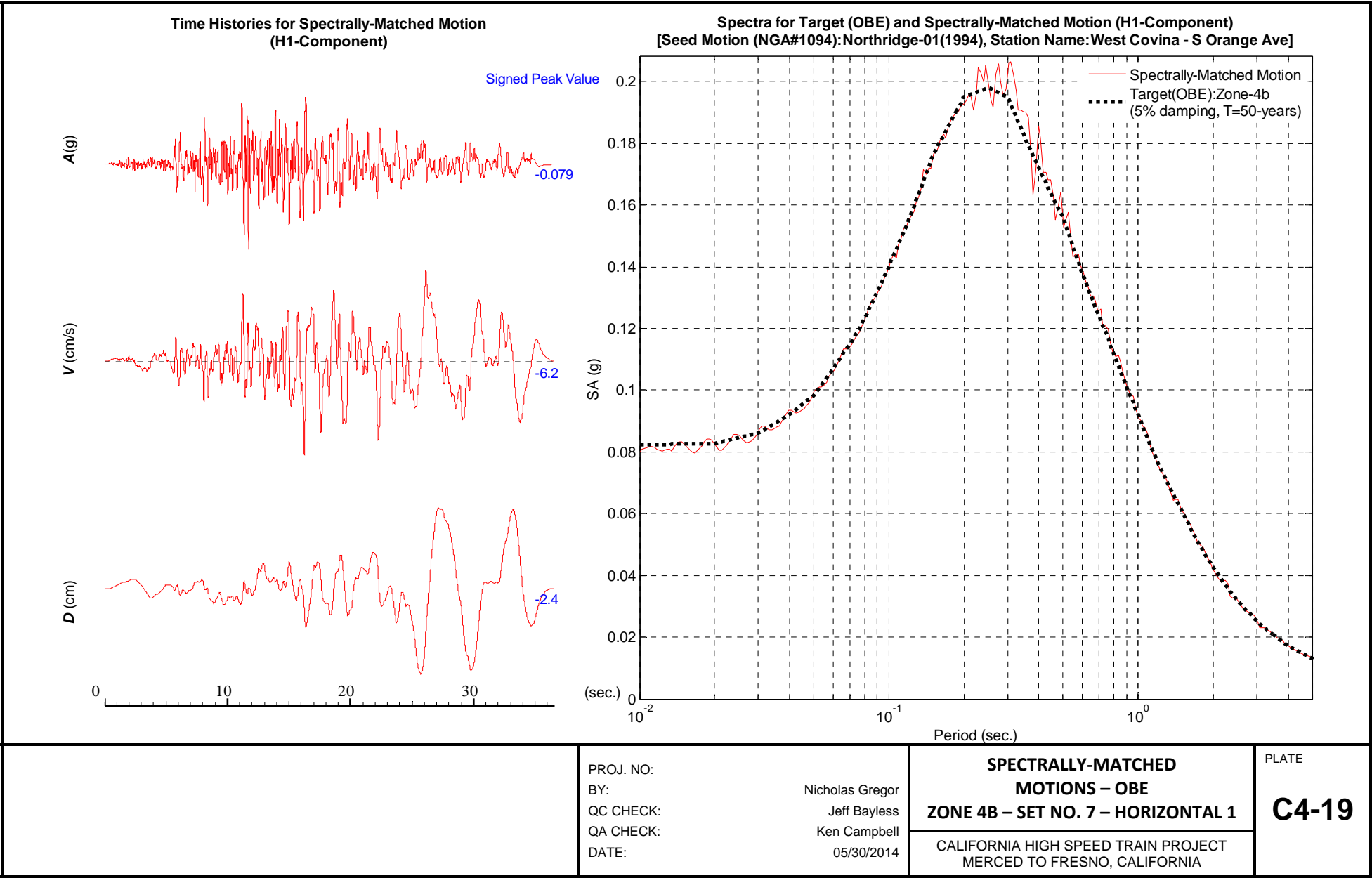






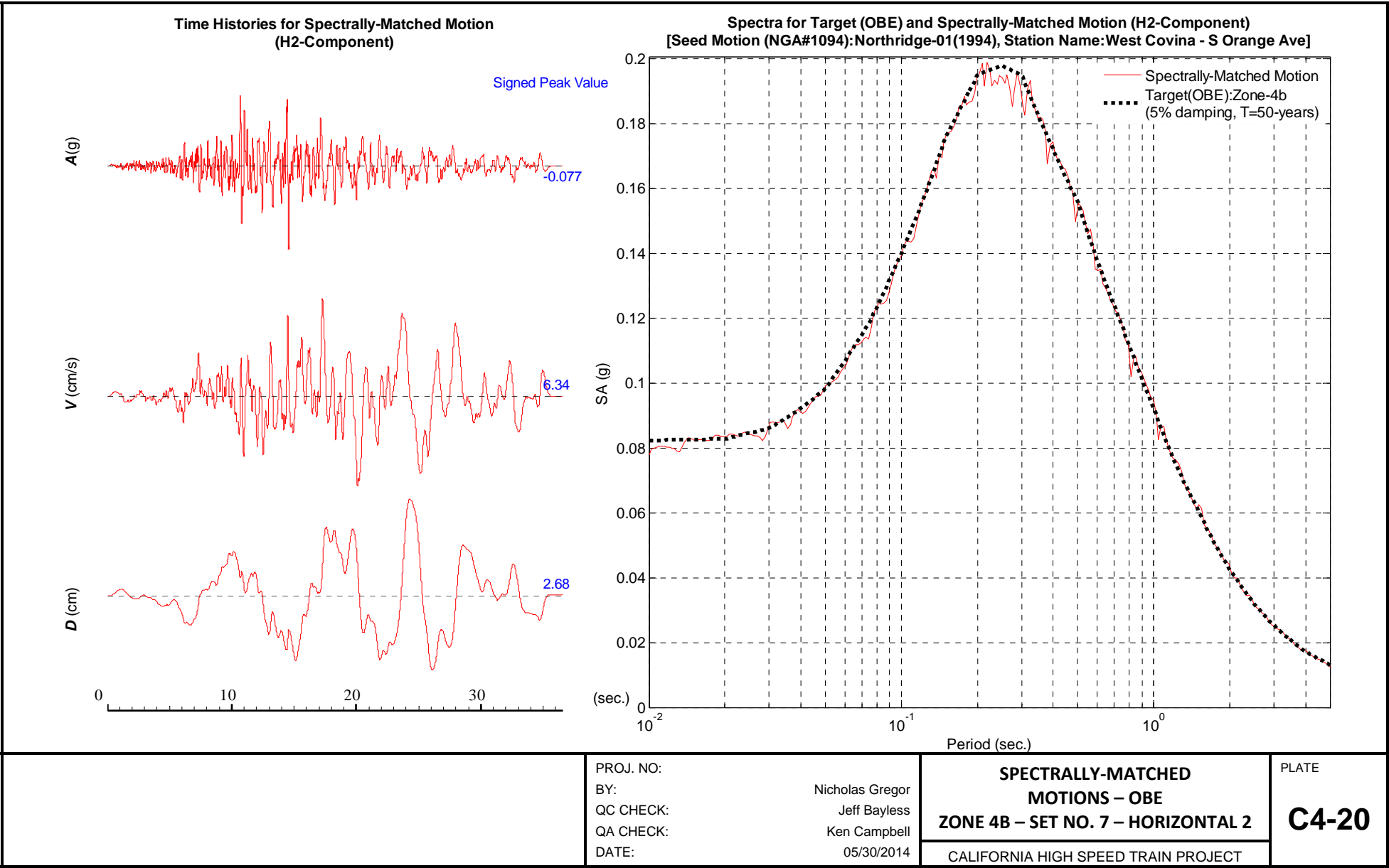


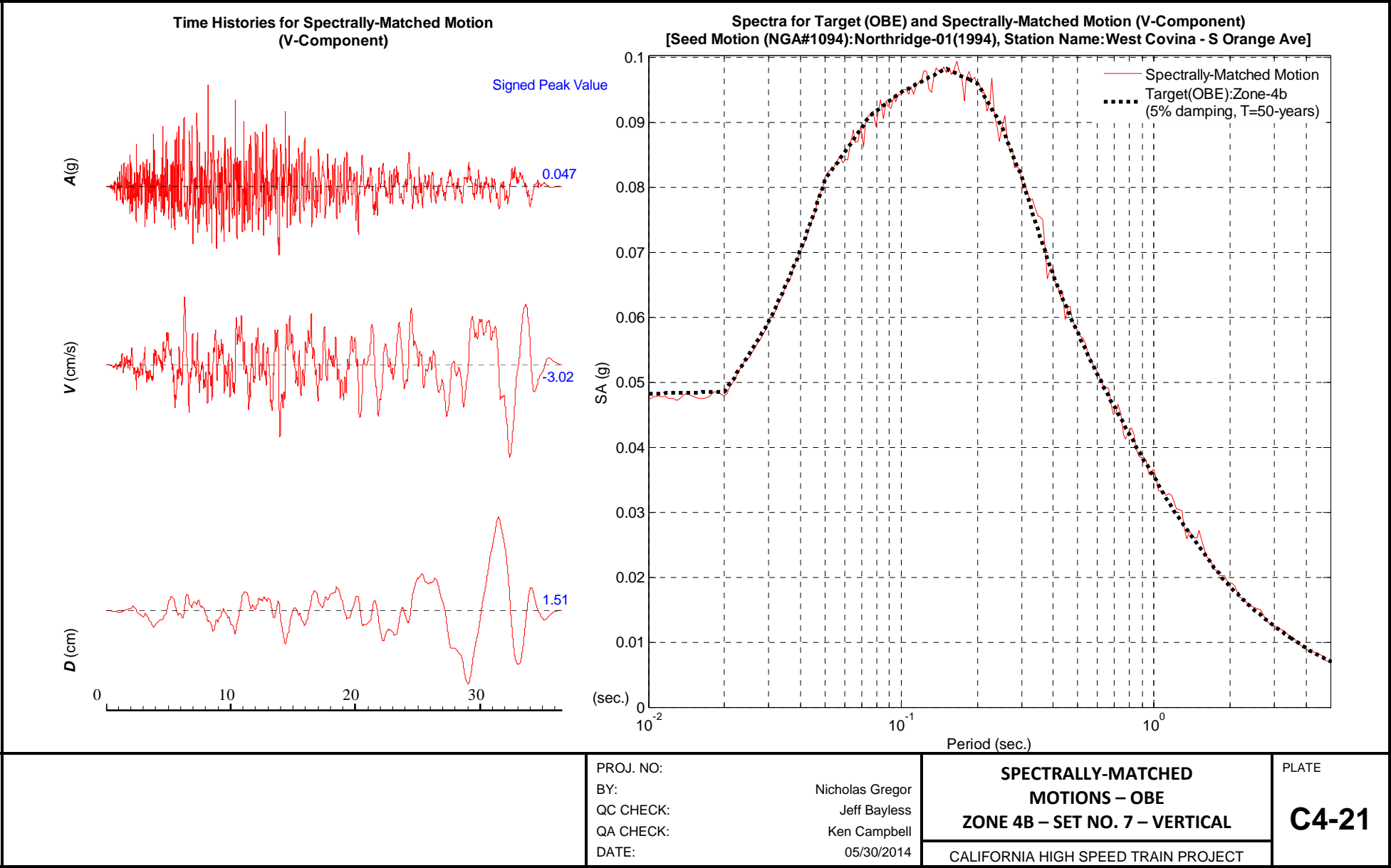
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**Table D.1:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for CP-2/3 SPECIAL SITES ( $V_{S30}=520$  m/s)**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.245	18.914	13.159	0.244	19.838	14.494	0.172	14.579	11.649
2	887	Landers	1992	Riverside Airport	7.28	96.00	0.244	16.512	10.864	0.243	17.101	9.259	0.170	12.049	6.271
3	172	Imperial Valley-06	1979	El Centro Array #1	6.53	21.68	0.246	26.255	10.301	0.243	23.293	15.207	0.171	11.972	6.873
4	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.236	21.314	11.351	0.247	24.224	13.063	0.172	13.735	7.080
5	747	Loma Prieta	1989	Bear Valley #7, Pinnacles	6.93	69.38	0.248	17.258	12.167	0.248	17.560	10.612	0.166	11.538	9.372
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.237	19.207	8.352	0.241	17.524	7.650	0.171	11.277	4.520
7	836	Landers	1992	Baker Fire Station	7.28	87.94	0.249	20.430	14.224	0.240	23.212	16.522	0.169	12.358	8.033

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QA CHECK:

DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

06/08/2014

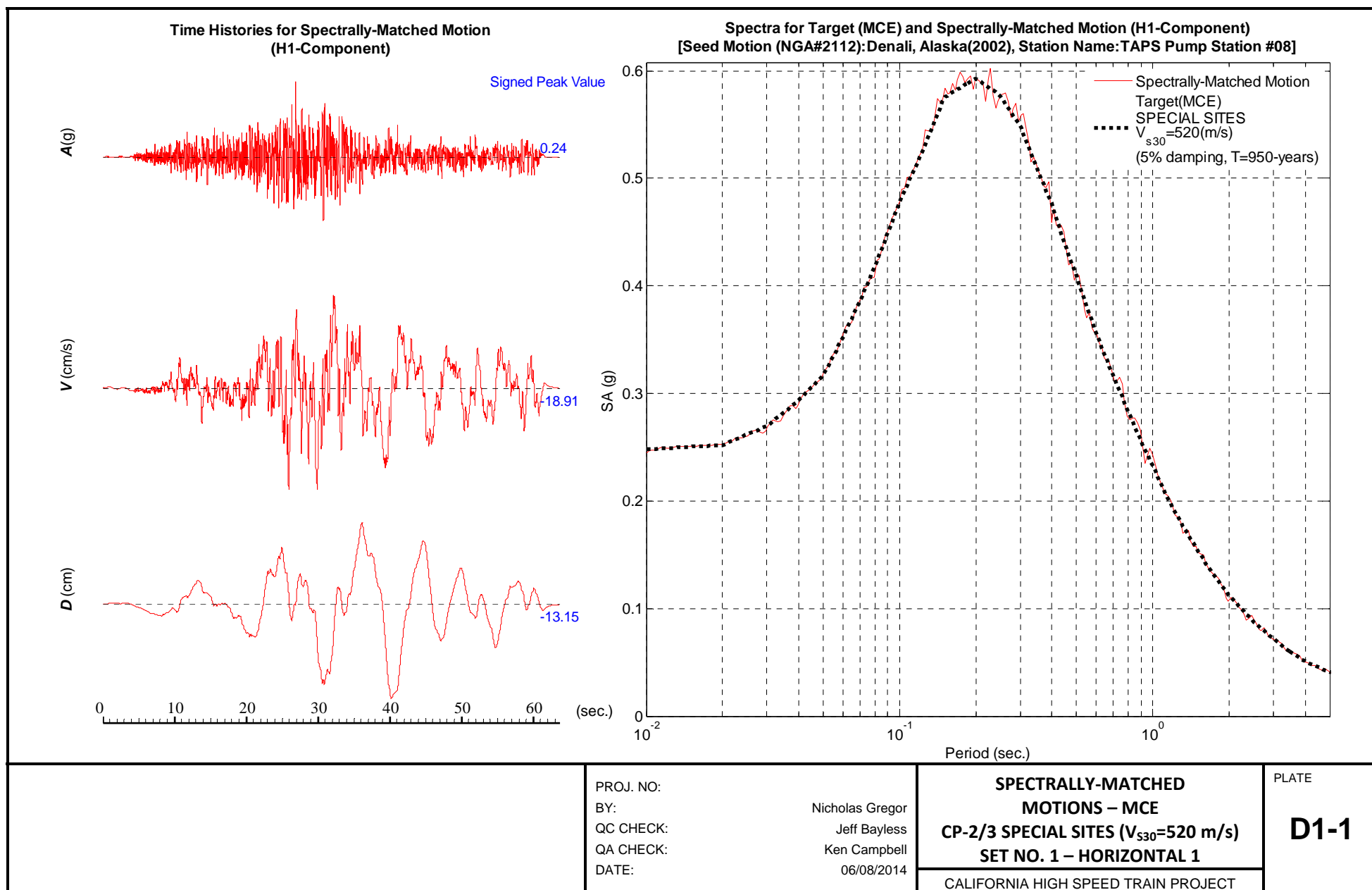
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MCE – CP-2/3 SPECIAL SITES ( $V_{S30}=520$  m/s)**

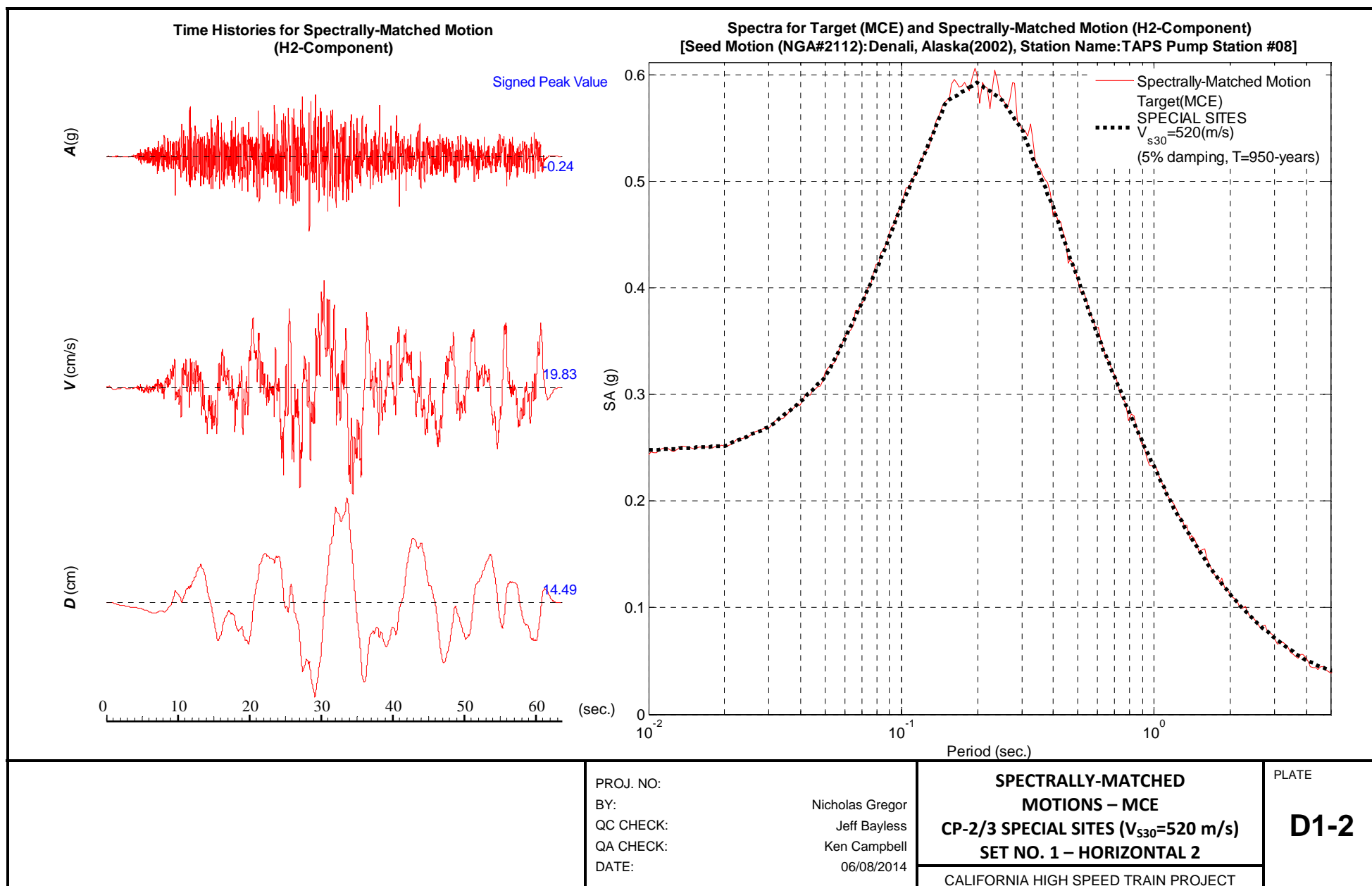
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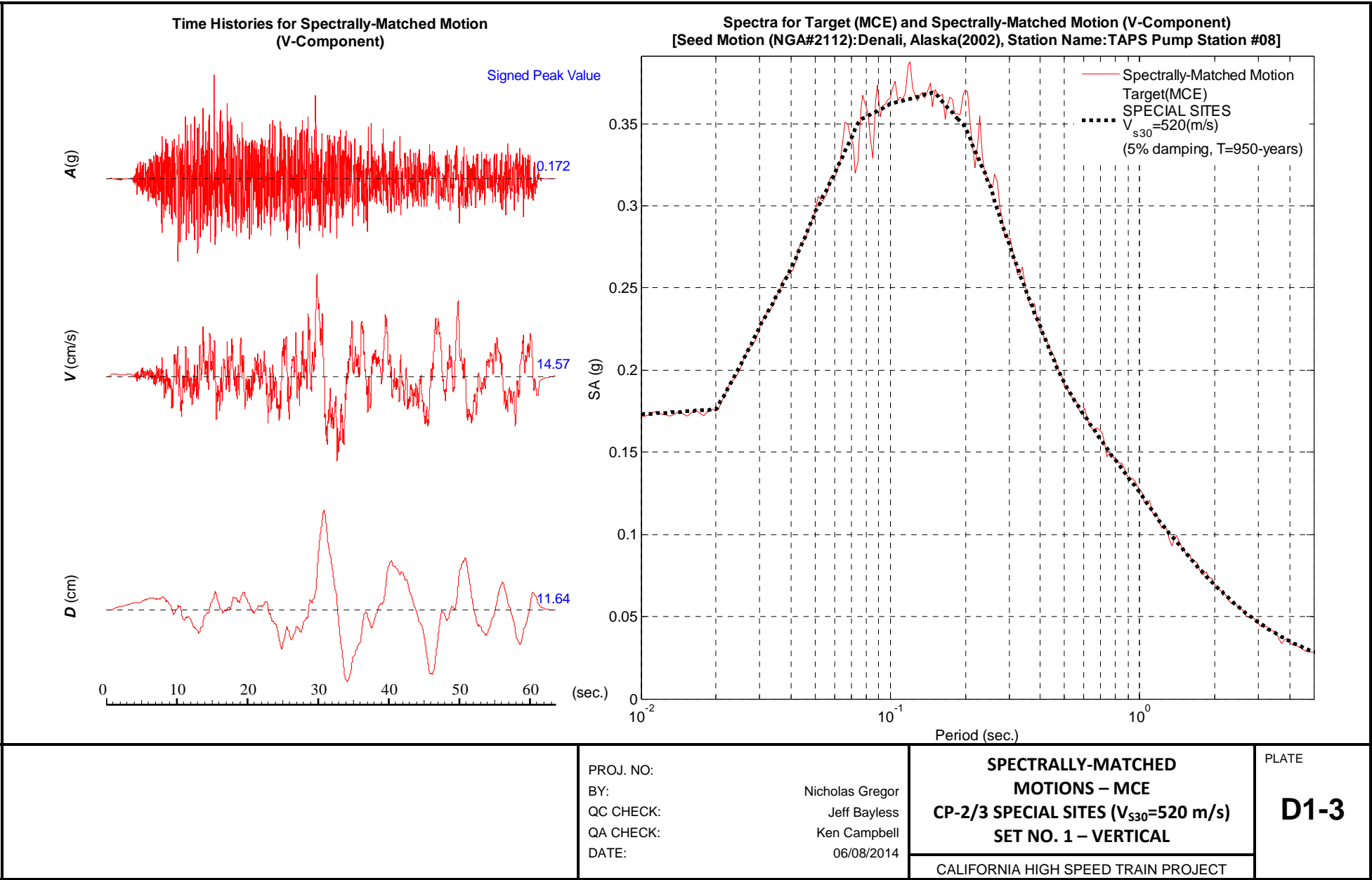
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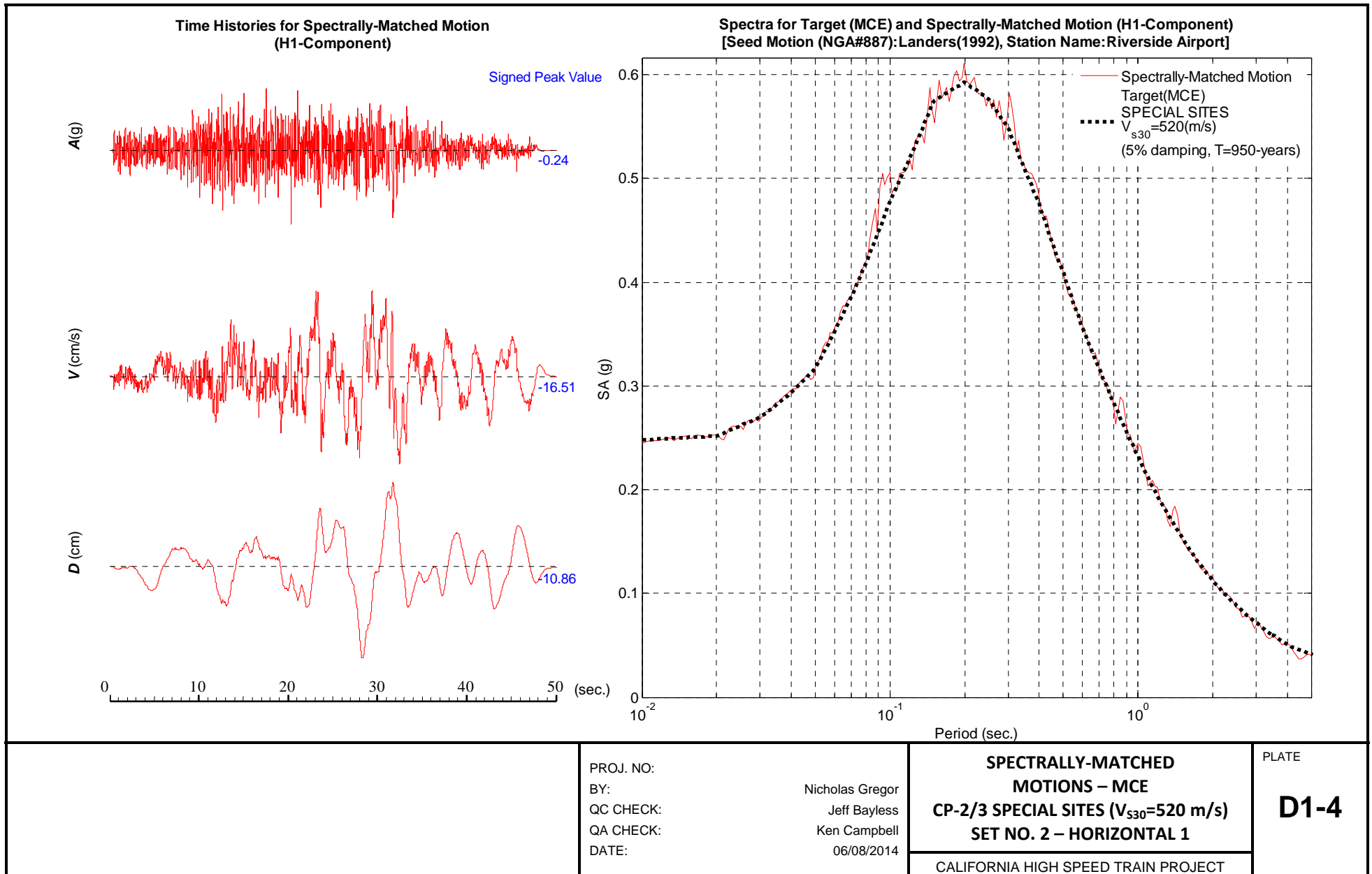
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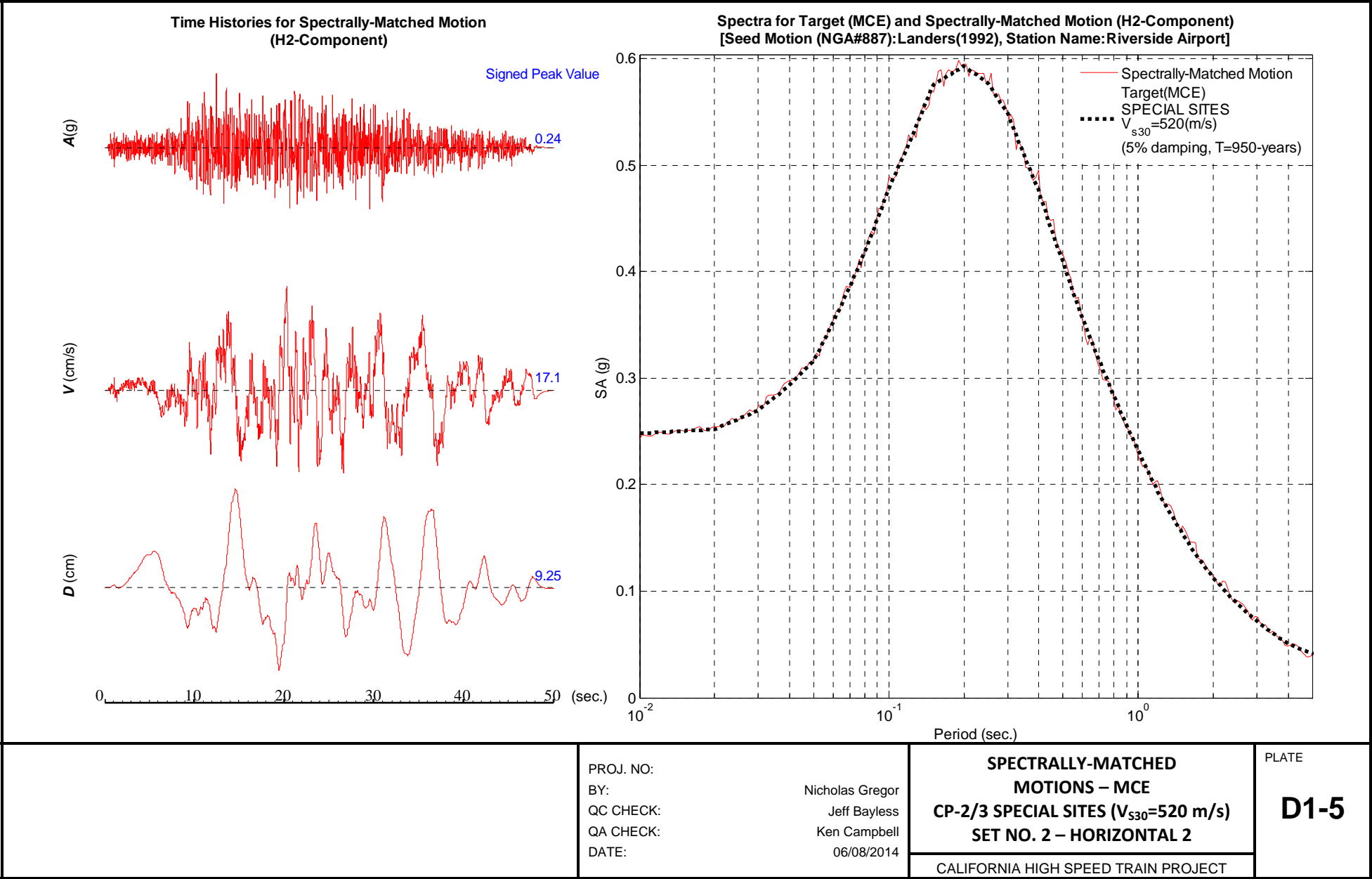
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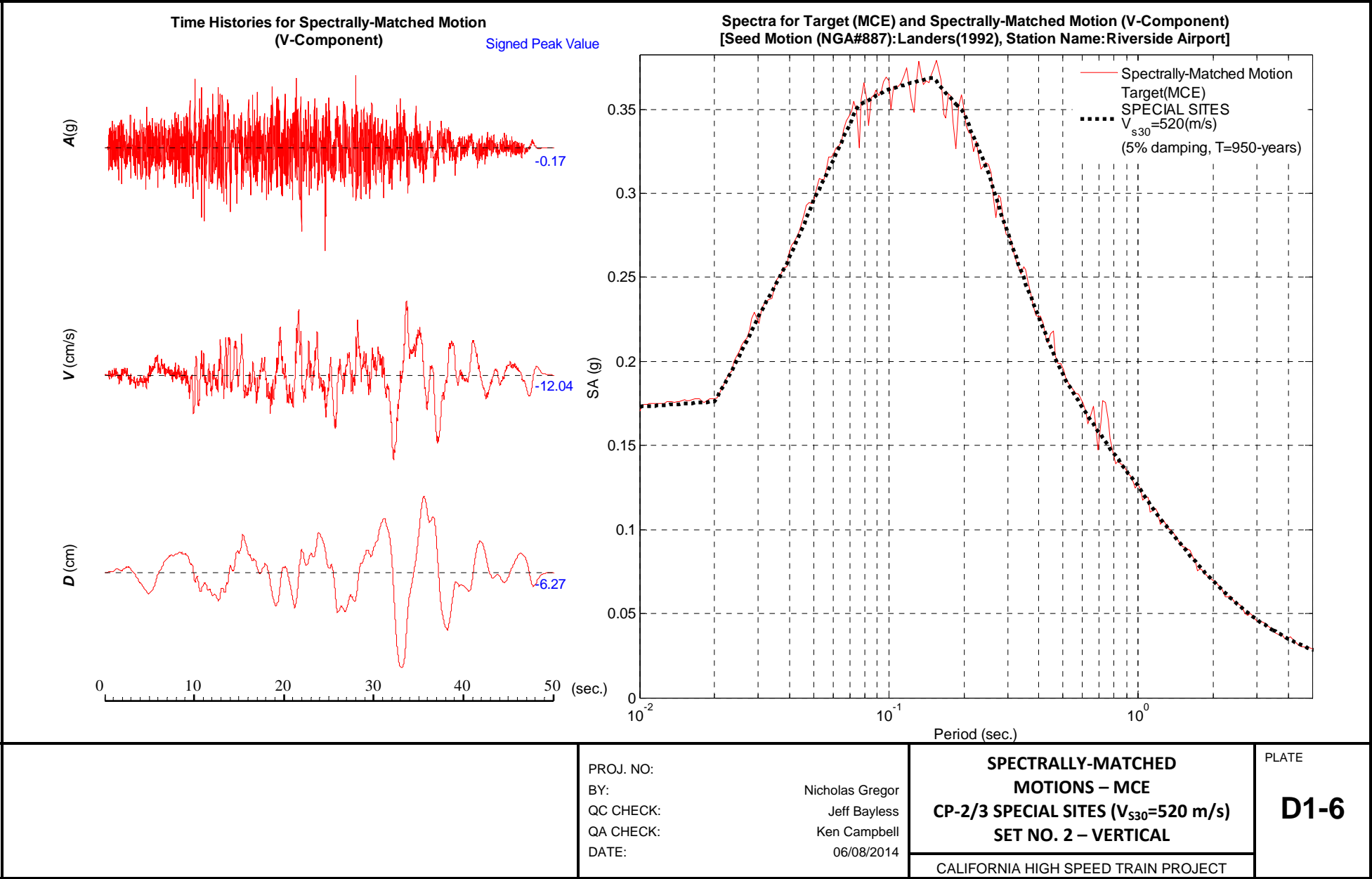




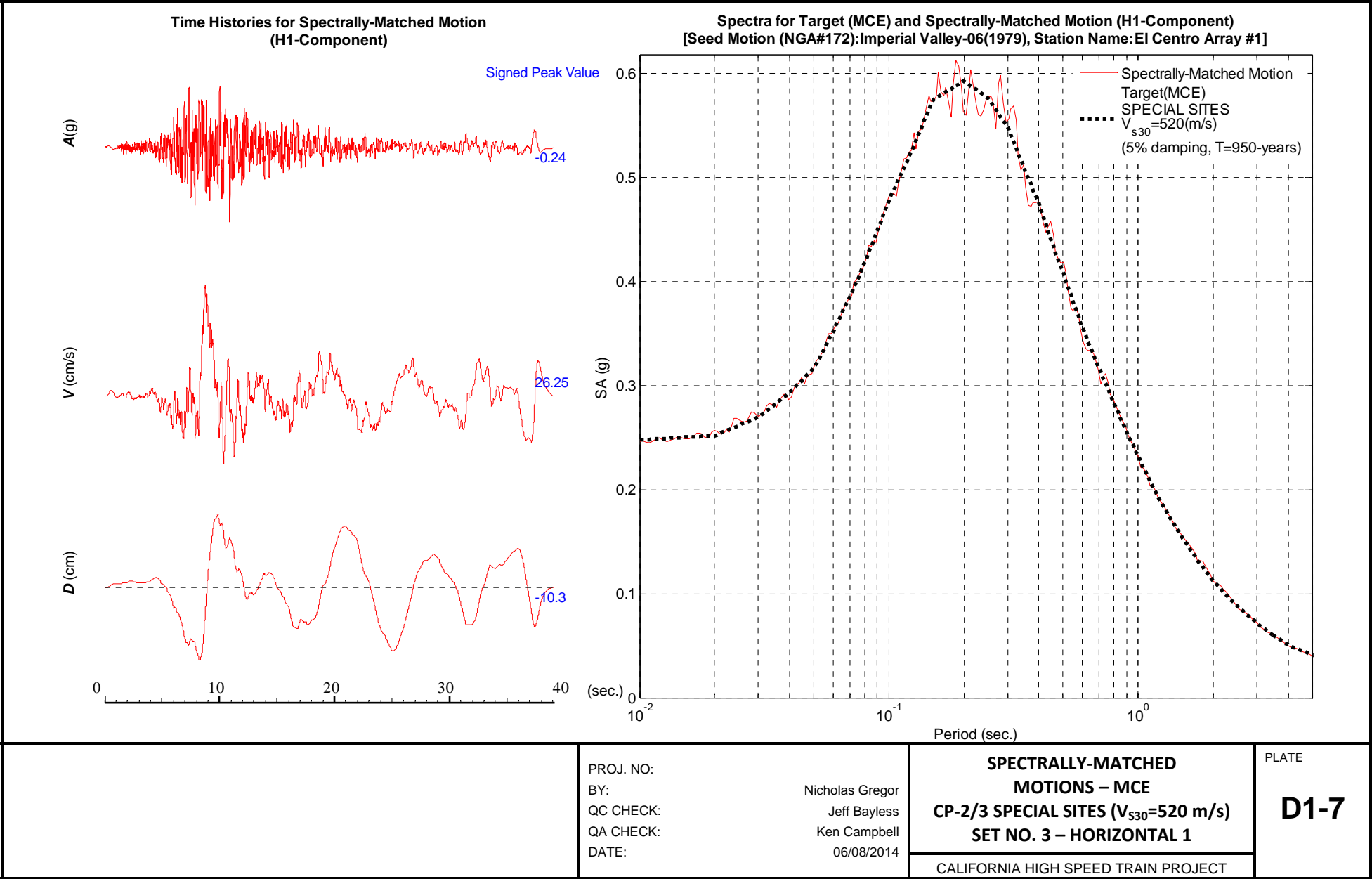


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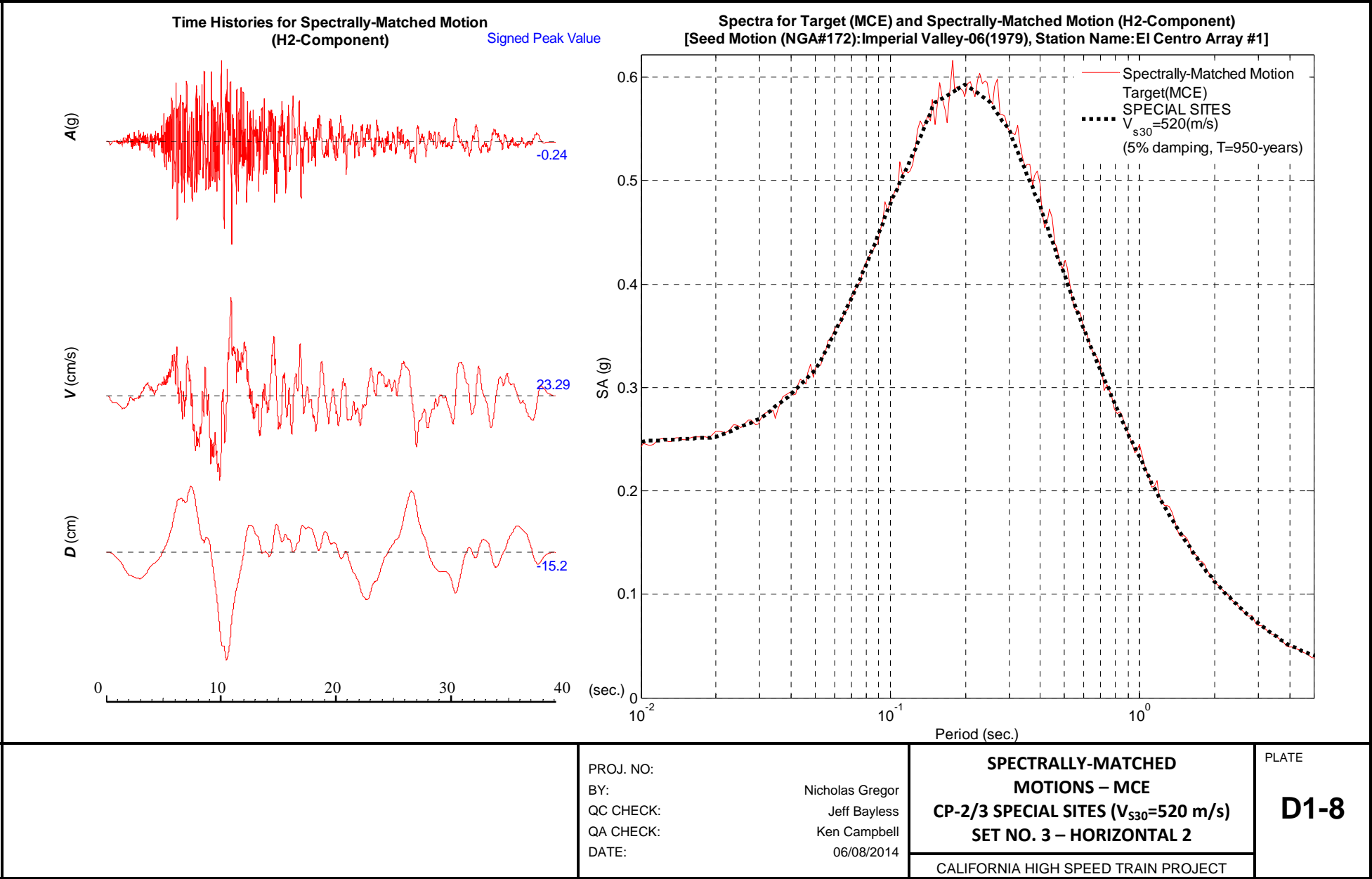




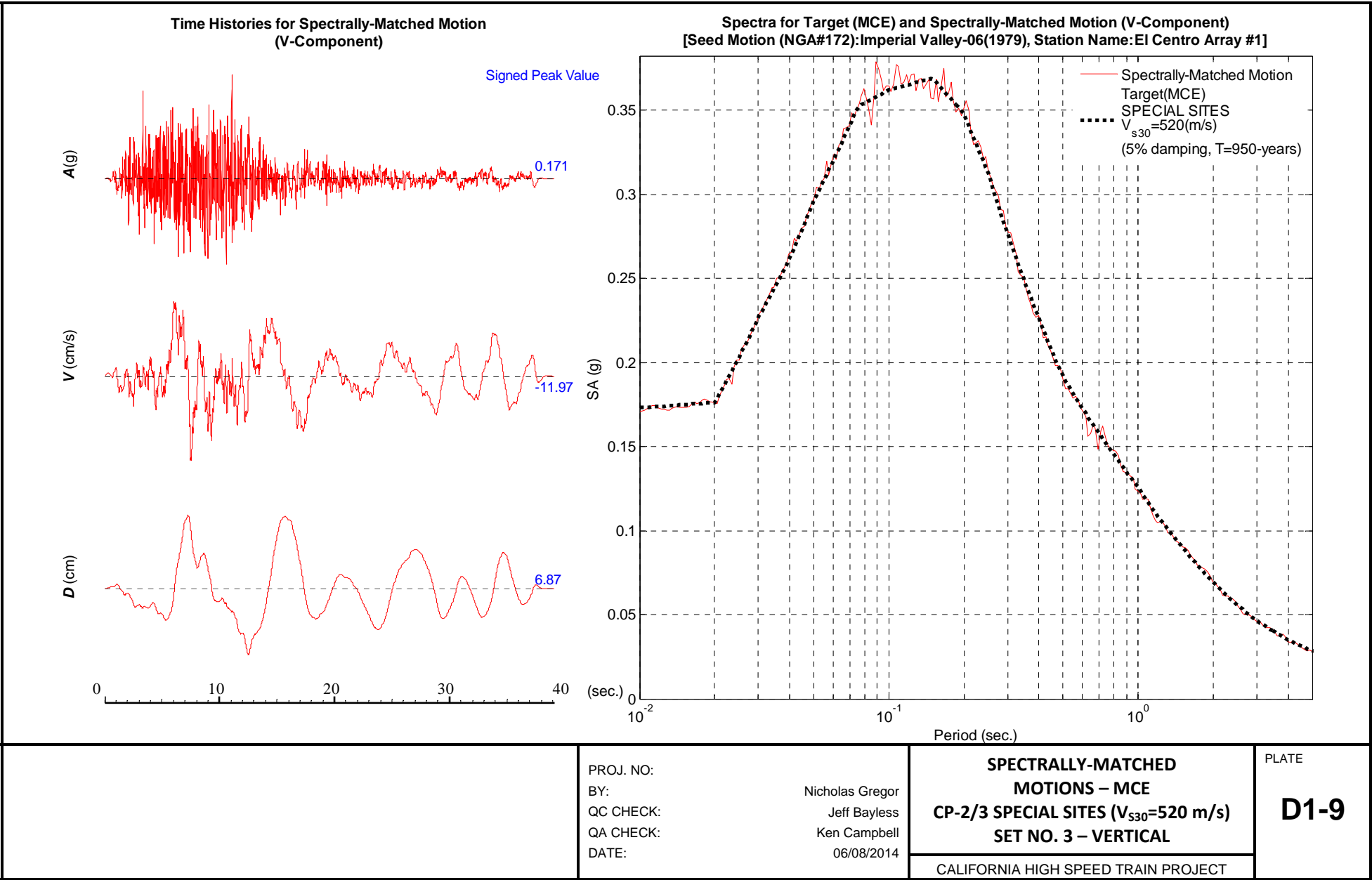
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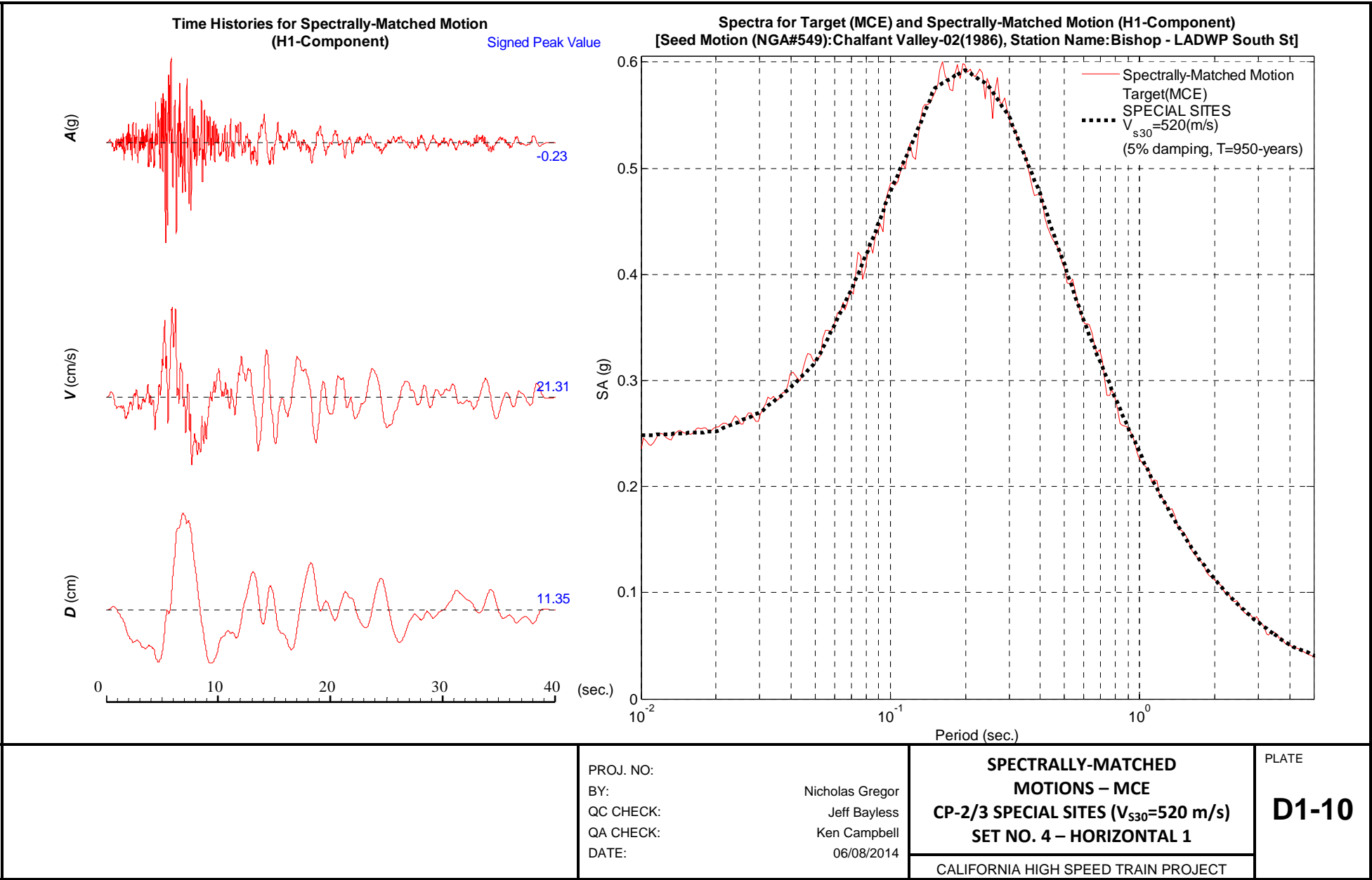


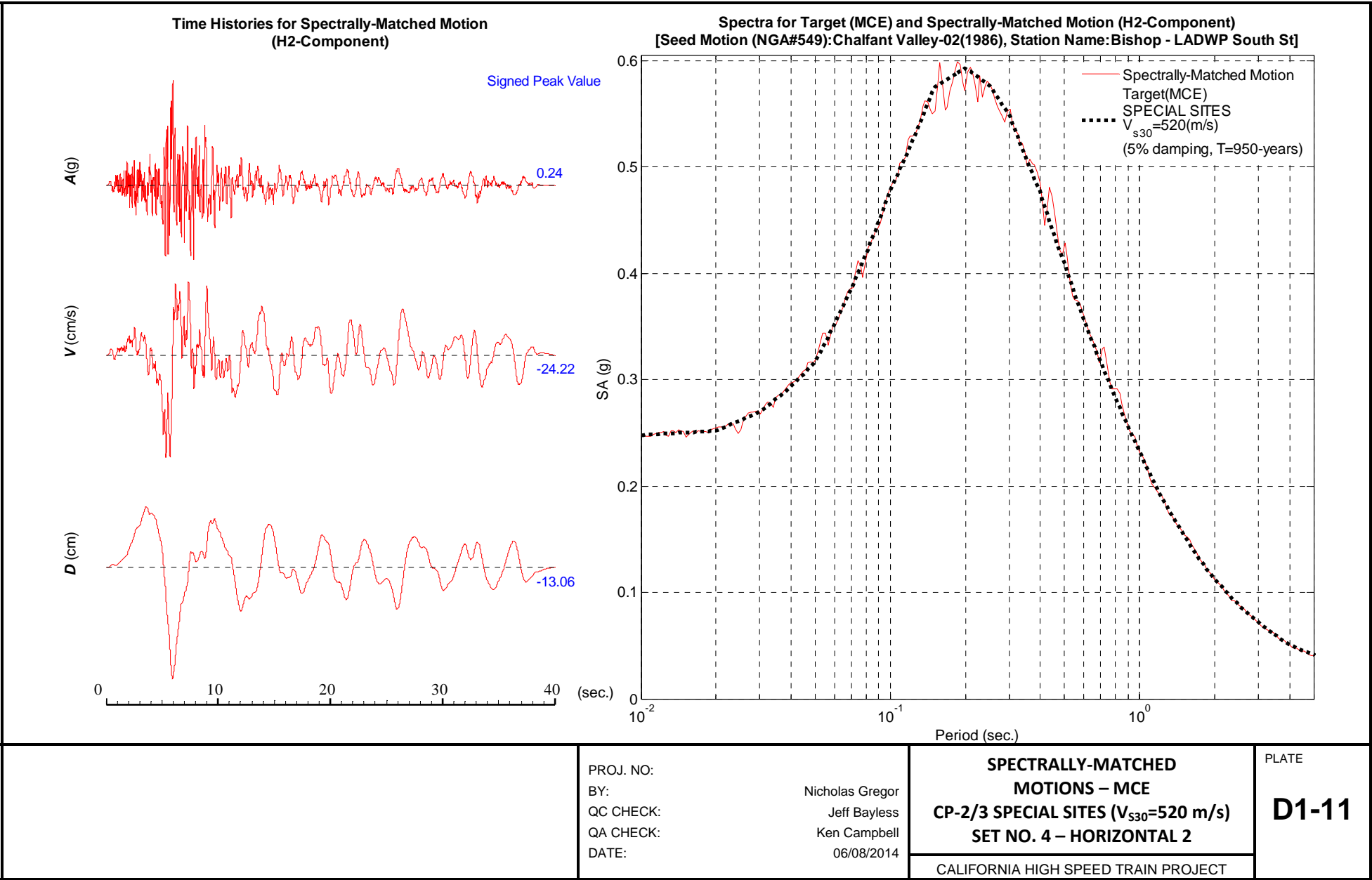
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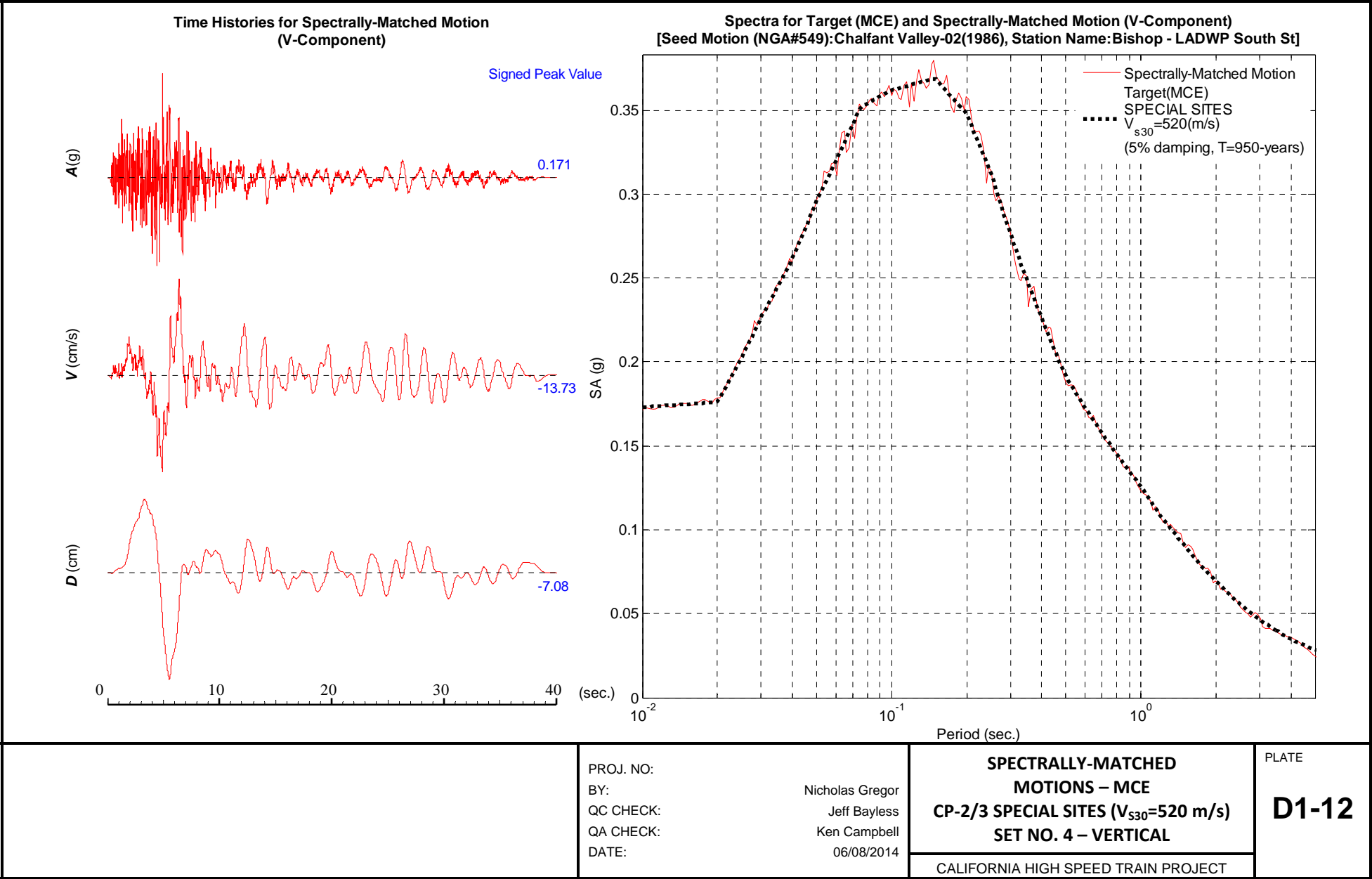


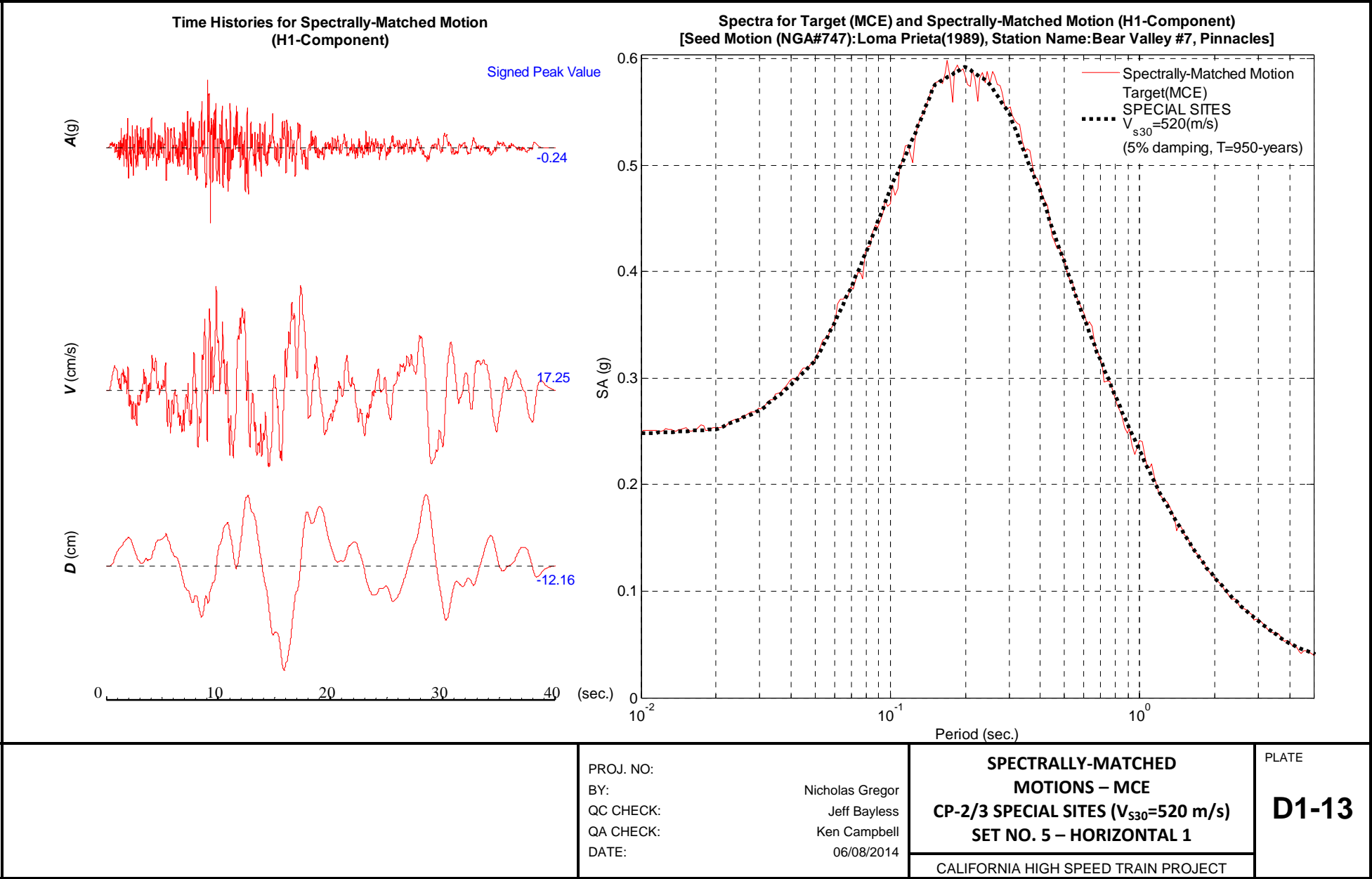
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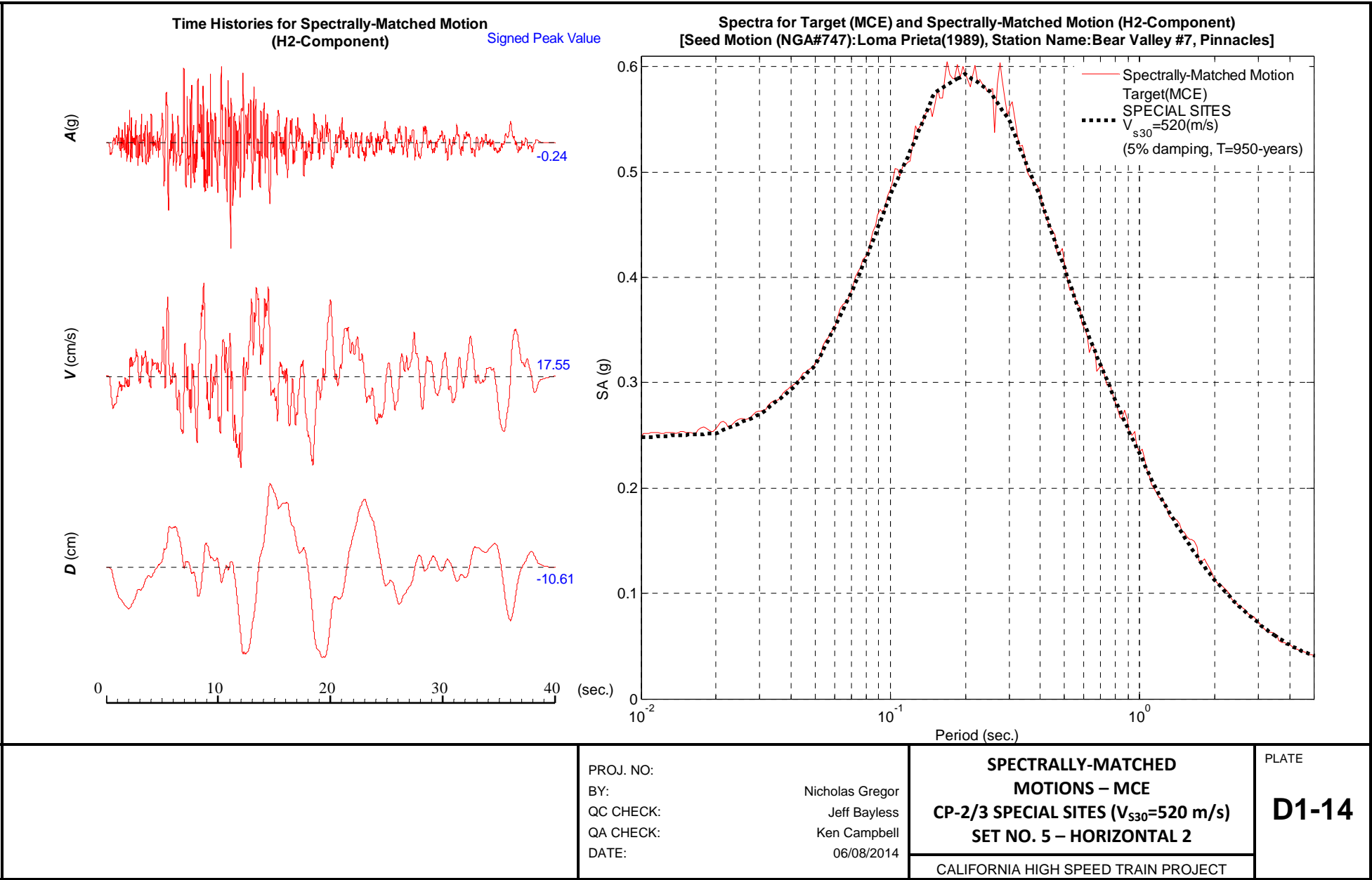






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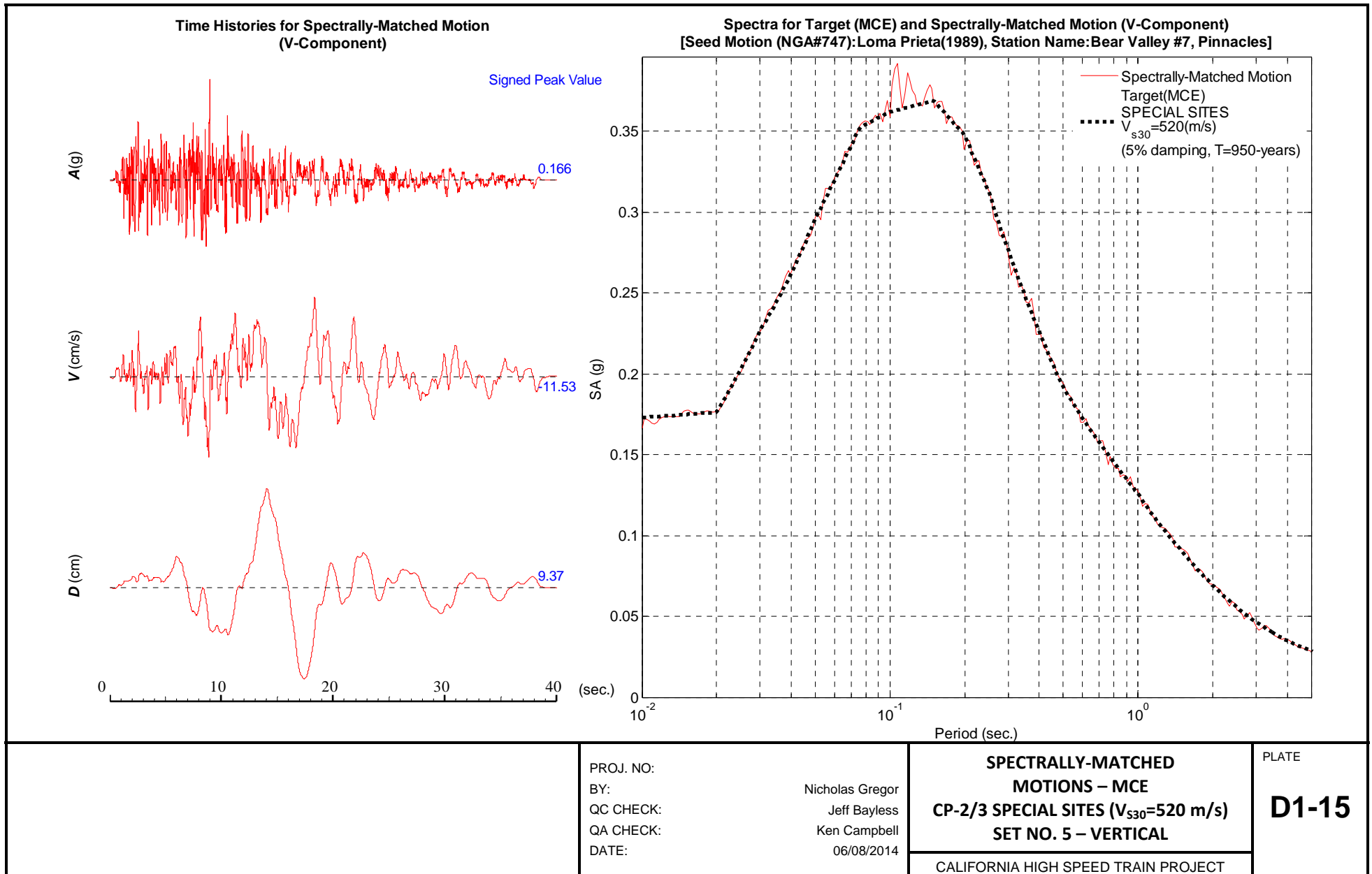
Nicholas Gregor  
Jeff Bayless  
Ken Campbell  
06/08/2014

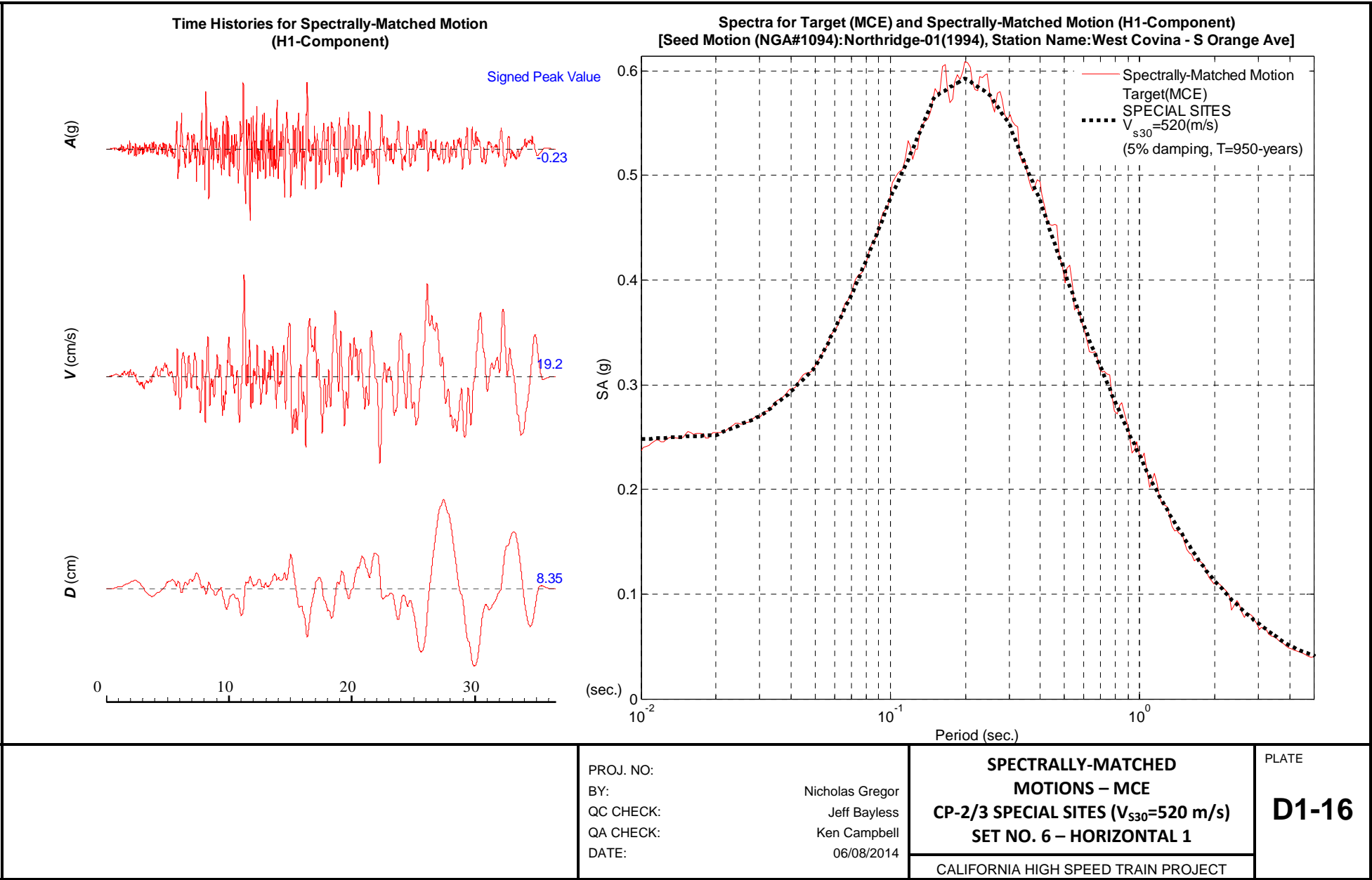
**SPECTRALLY-MATCHED  
MOTIONS – MCE  
CP-2/3 SPECIAL SITES (V<sub>s30</sub>=520 m/s)  
SET NO. 5 – HORIZONTAL 2**

CALIFORNIA HIGH SPEED TRAIN PROJECT

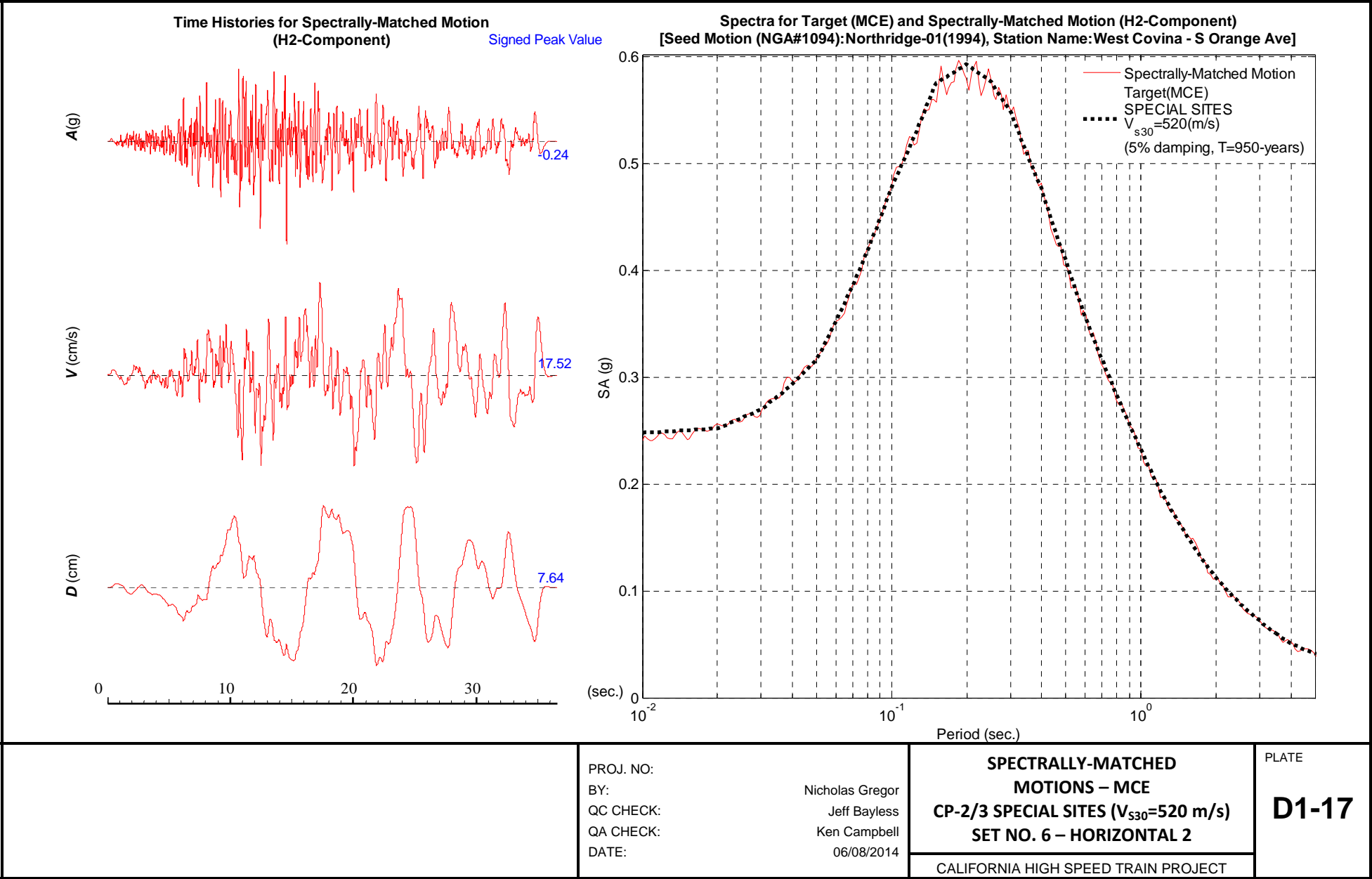
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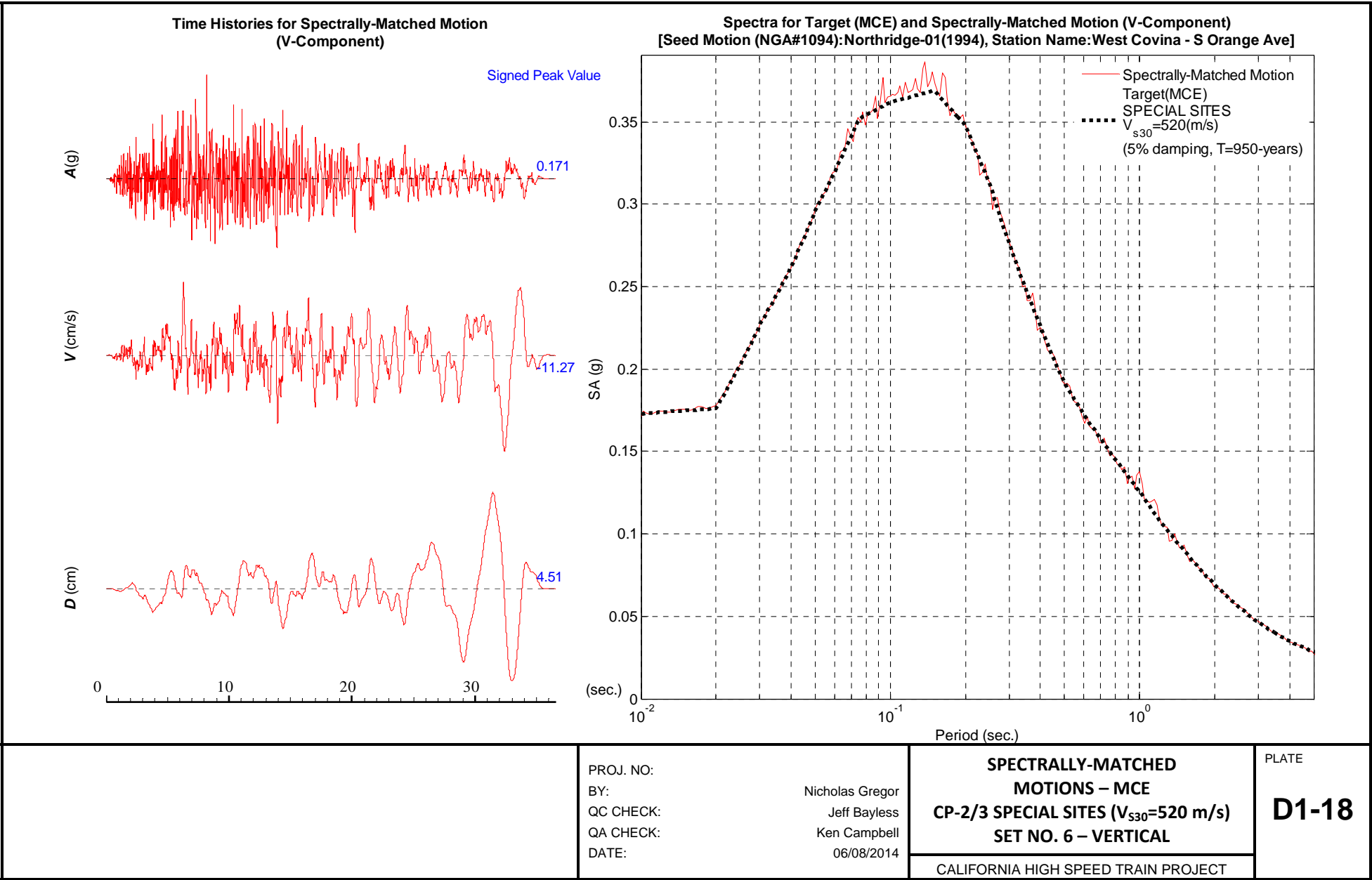


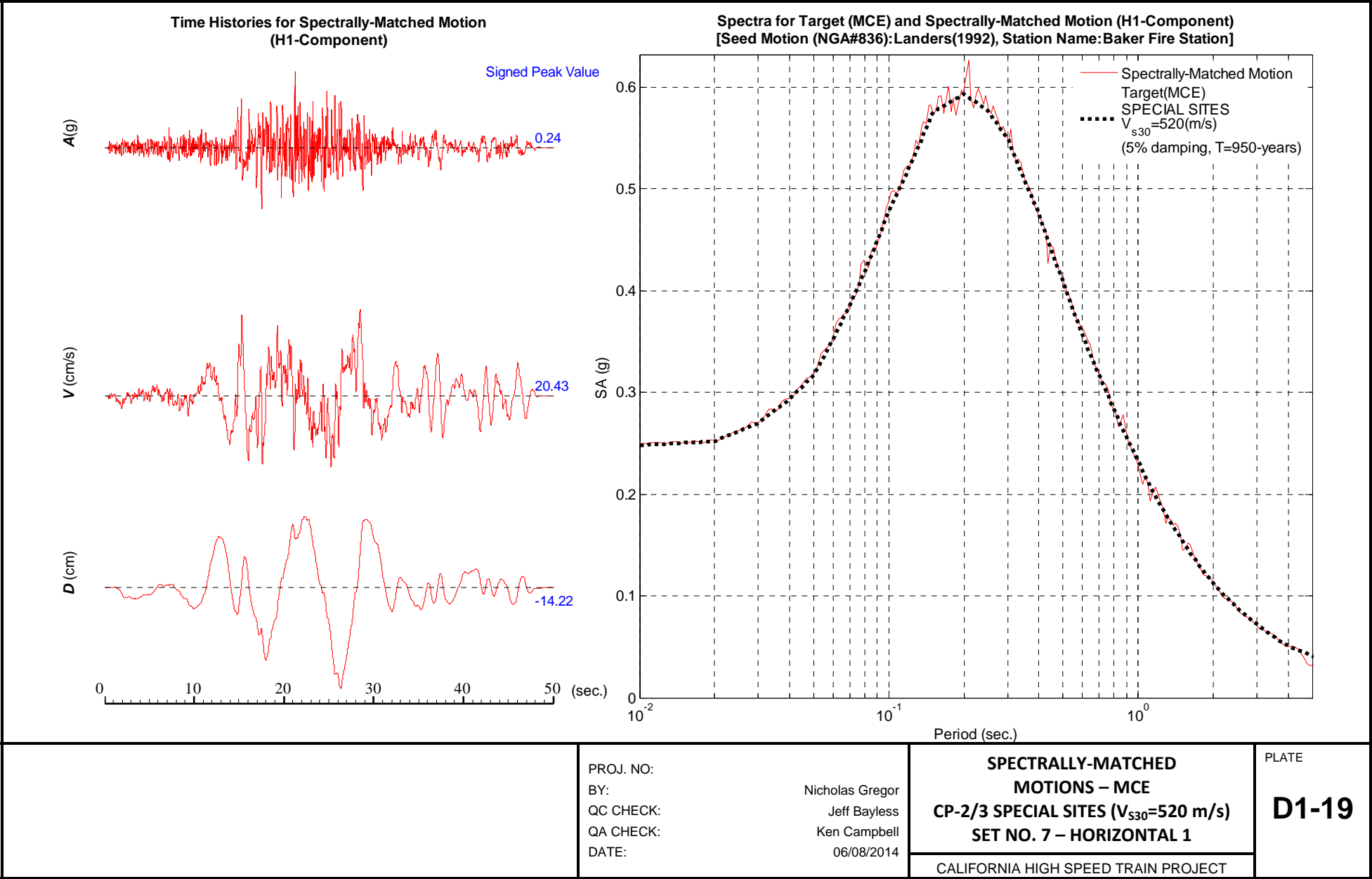


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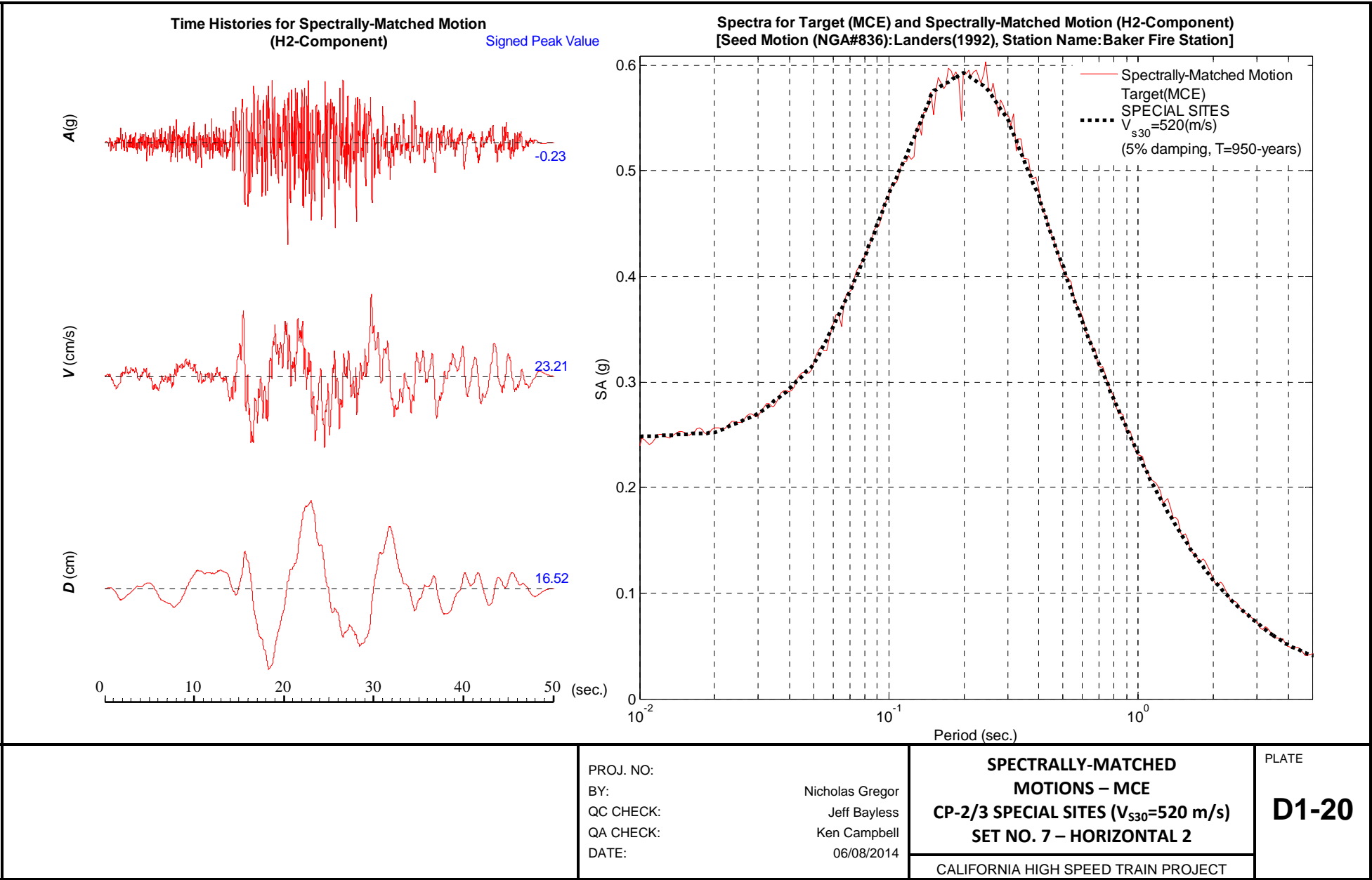


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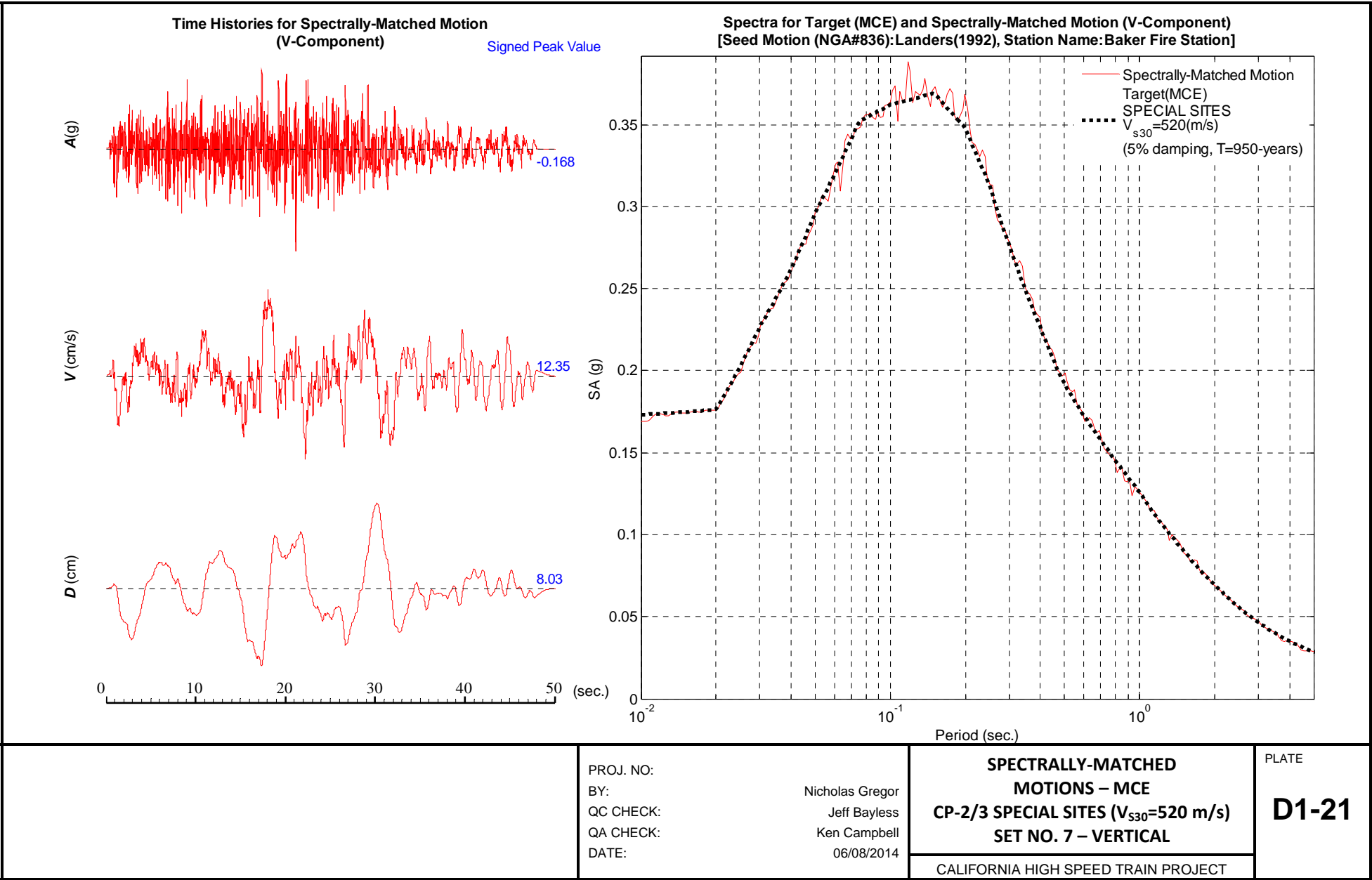




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**Table D.3:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for CP-2/3 Special Sites ( $V_{S30}=760$  m/s)**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.220	14.908	10.629	0.218	15.689	12.054	0.147	13.459	10.898
2	887	Landers	1992	Riverside Airport	7.28	96.00	0.218	13.340	8.923	0.217	12.889	7.499	0.150	10.600	5.220
3	172	Imperial Valley-06	1979	El Centro Array #1	6.53	21.68	0.218	20.261	8.057	0.217	18.405	12.379	0.147	10.839	6.048
4	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.210	16.875	8.919	0.219	19.023	10.326	0.151	11.834	5.984
5	747	Loma Prieta	1989	Bear Valley #7, Pinnacles	6.93	69.38	0.219	13.793	9.964	0.222	13.608	8.427	0.146	10.477	8.432
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.214	15.556	6.634	0.212	14.063	6.241	0.148	9.965	3.827
7	836	Landers	1992	Baker Fire Station	7.28	87.94	0.215	16.398	11.699	0.213	18.694	13.874	0.145	11.150	7.499

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QC CHECK:

QA CHECK:

DATE:

Nicholas Gregor

Jeff Bayless

Ken Campbell

06/08/2014

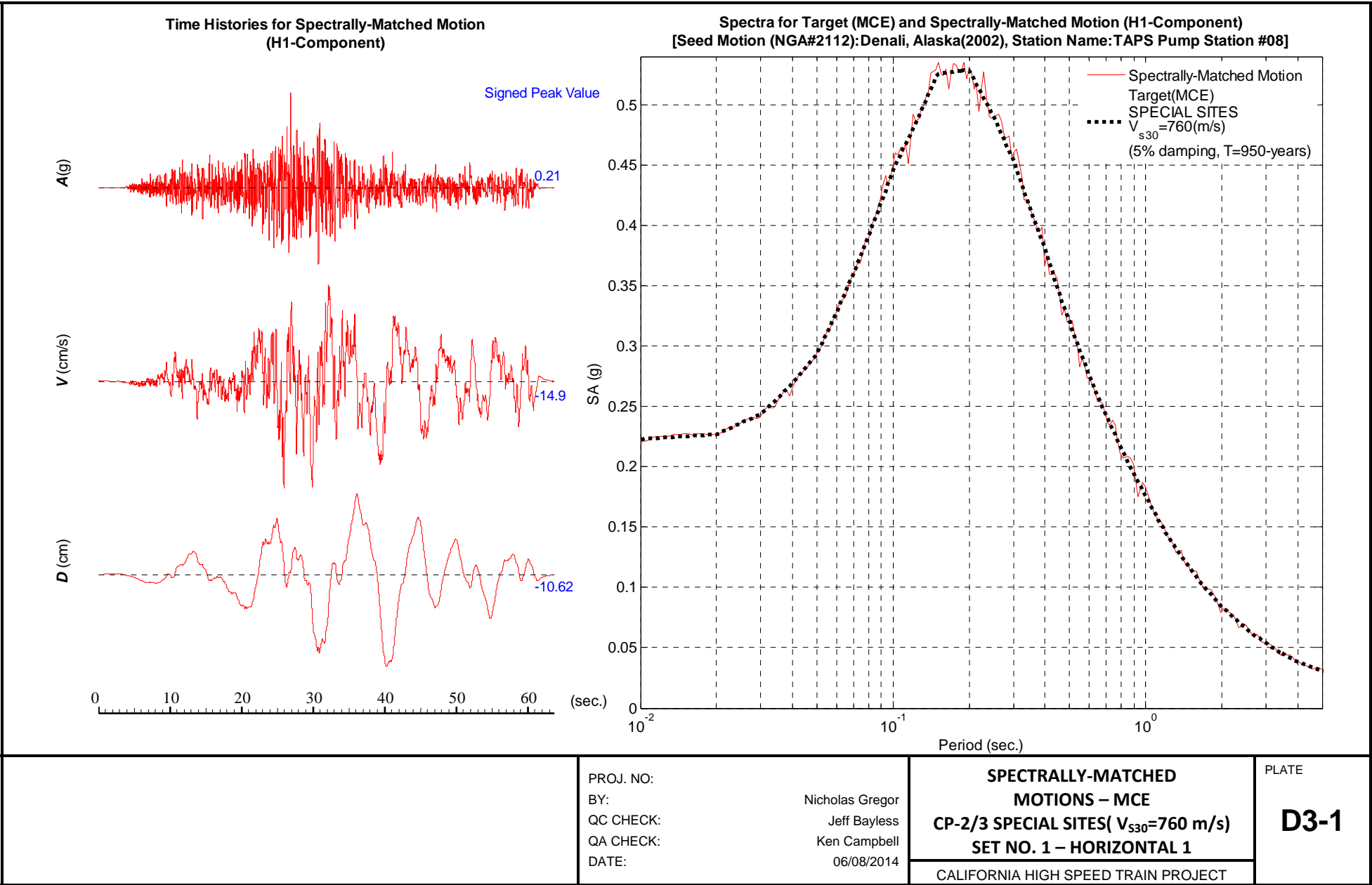
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
MCE – CP-2/3 SPECIAL SITES(  $V_{S30}=760$  m/s)**

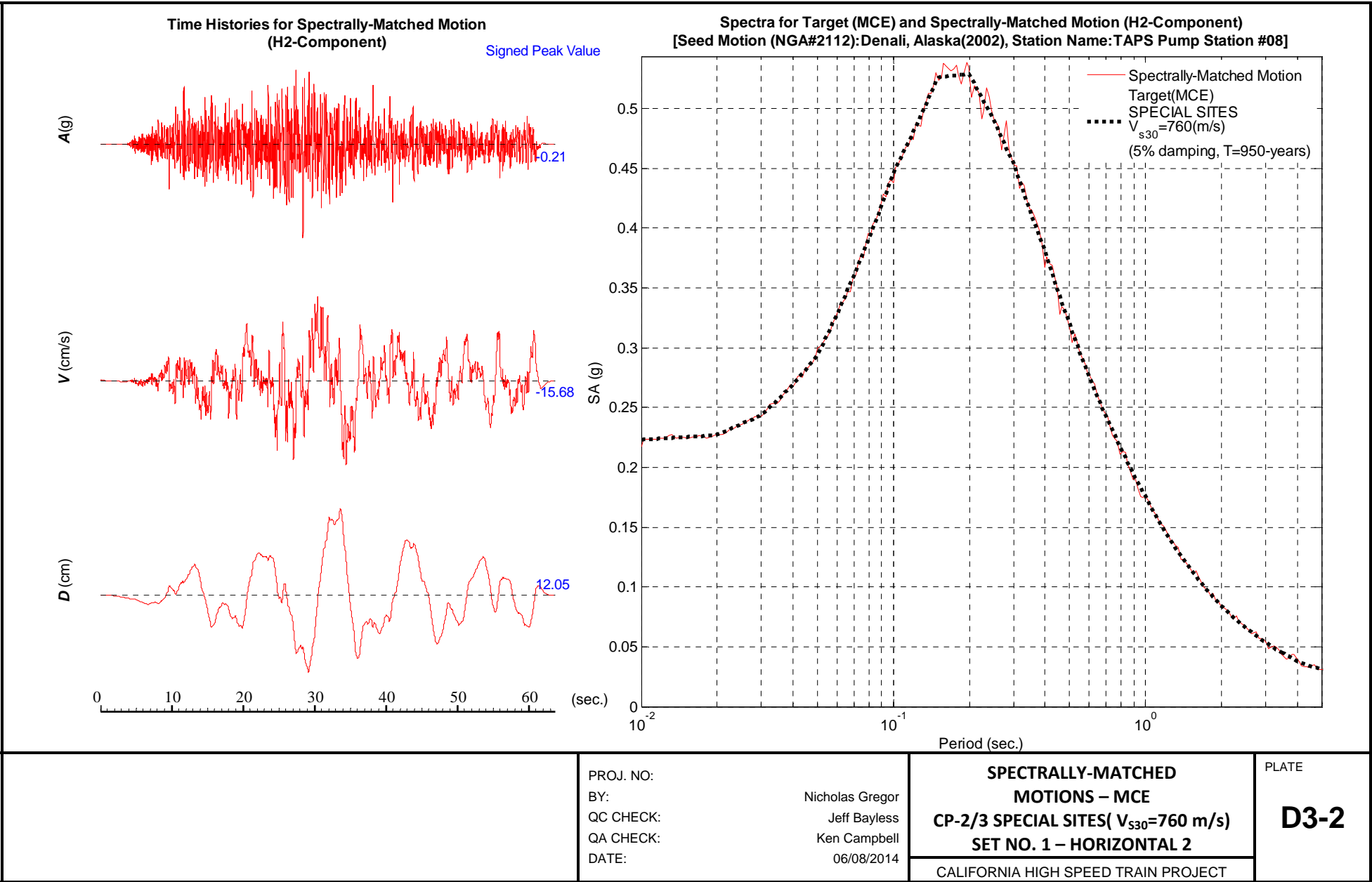
CALIFORNIA HIGH SPEED TRAIN PROJECT

PLATE

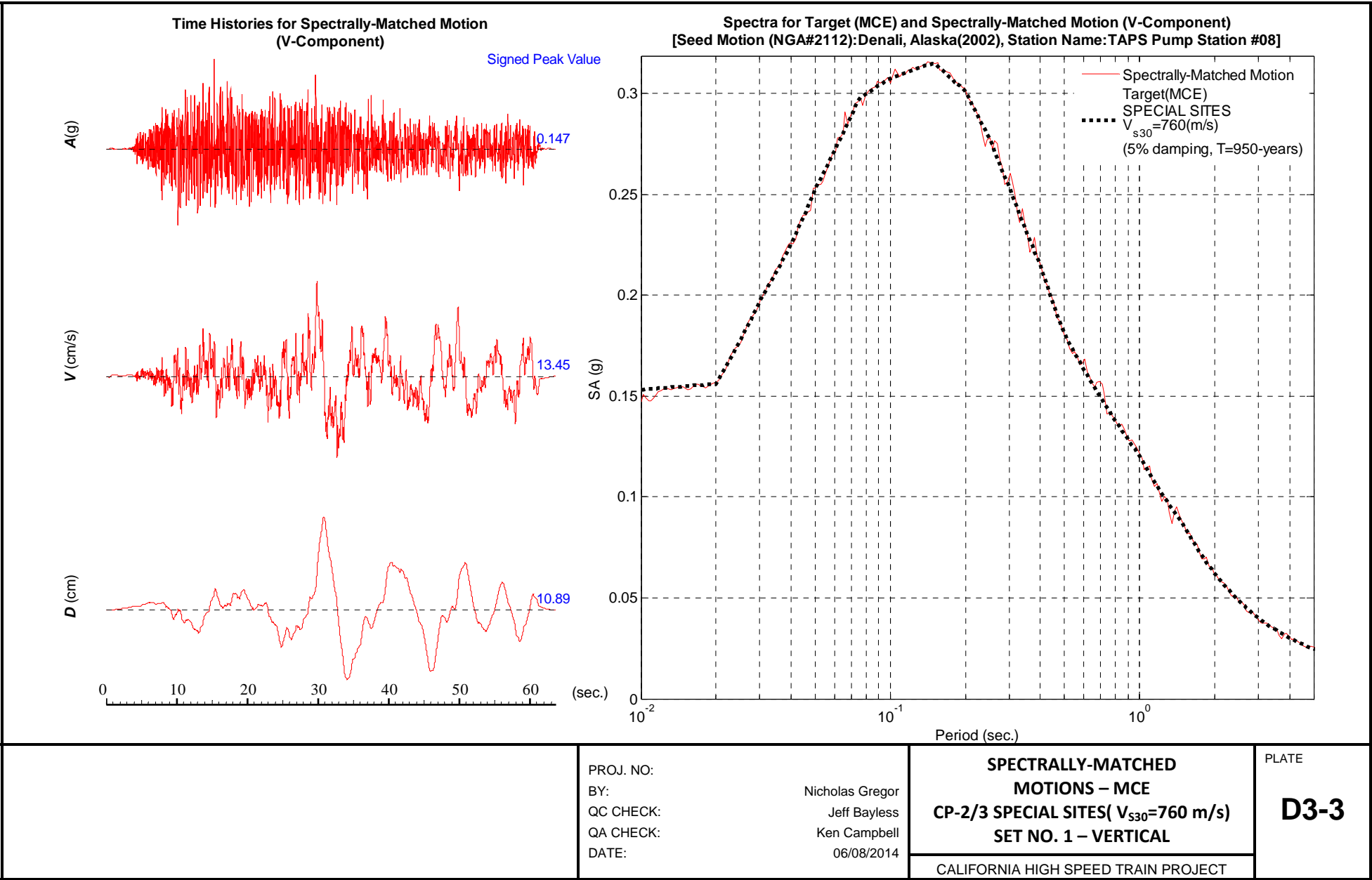
**D3-0**

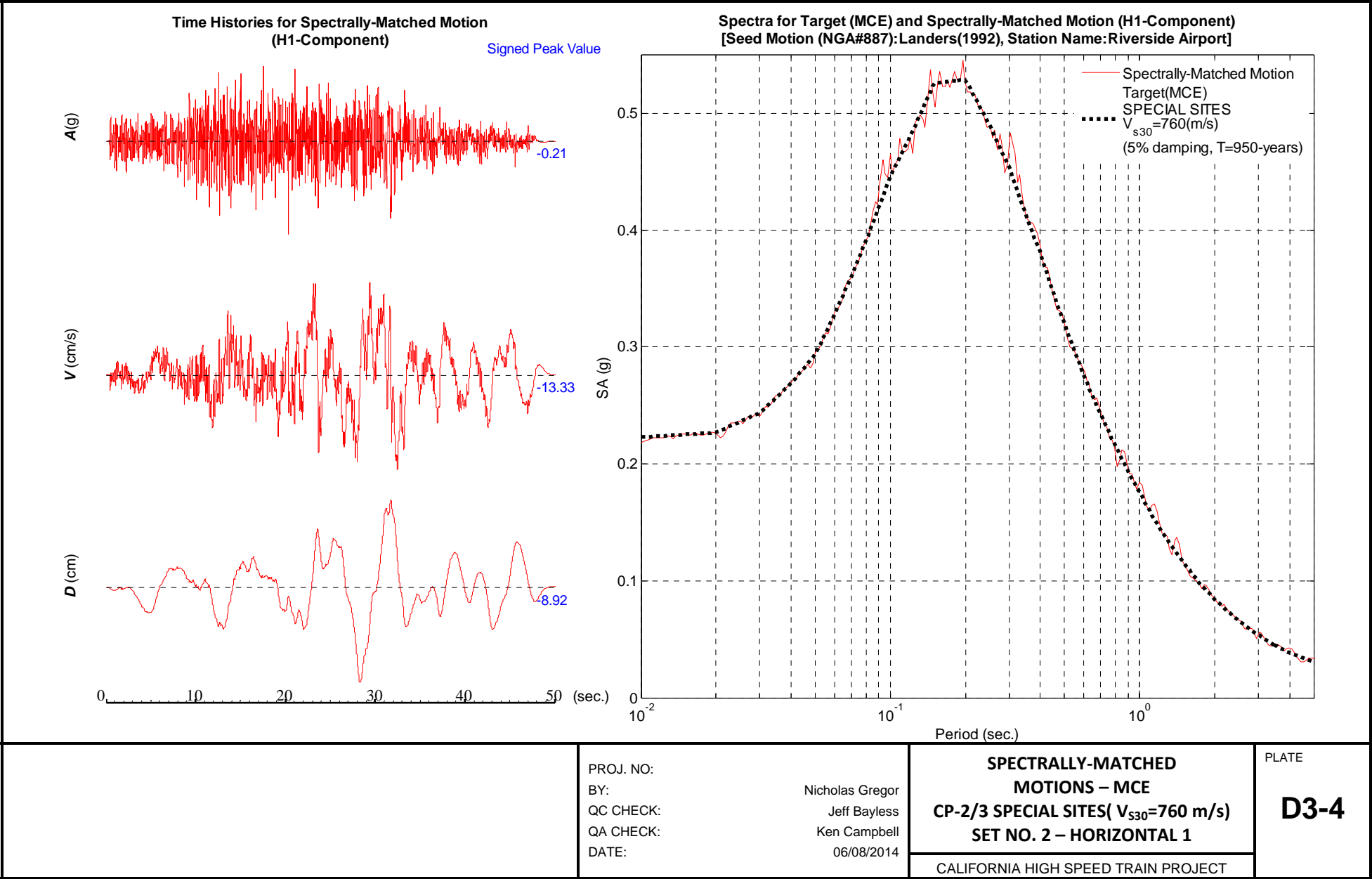
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

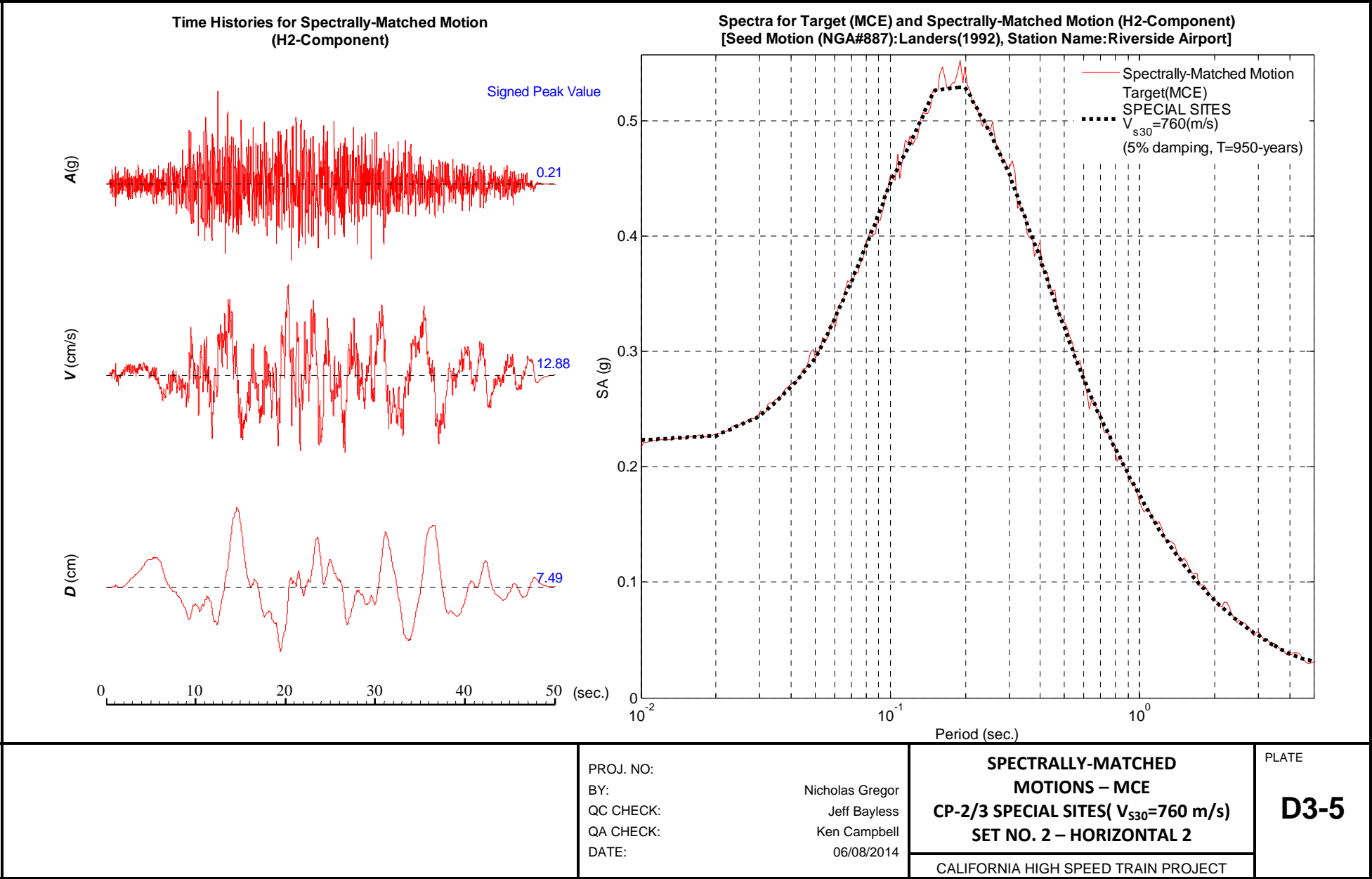


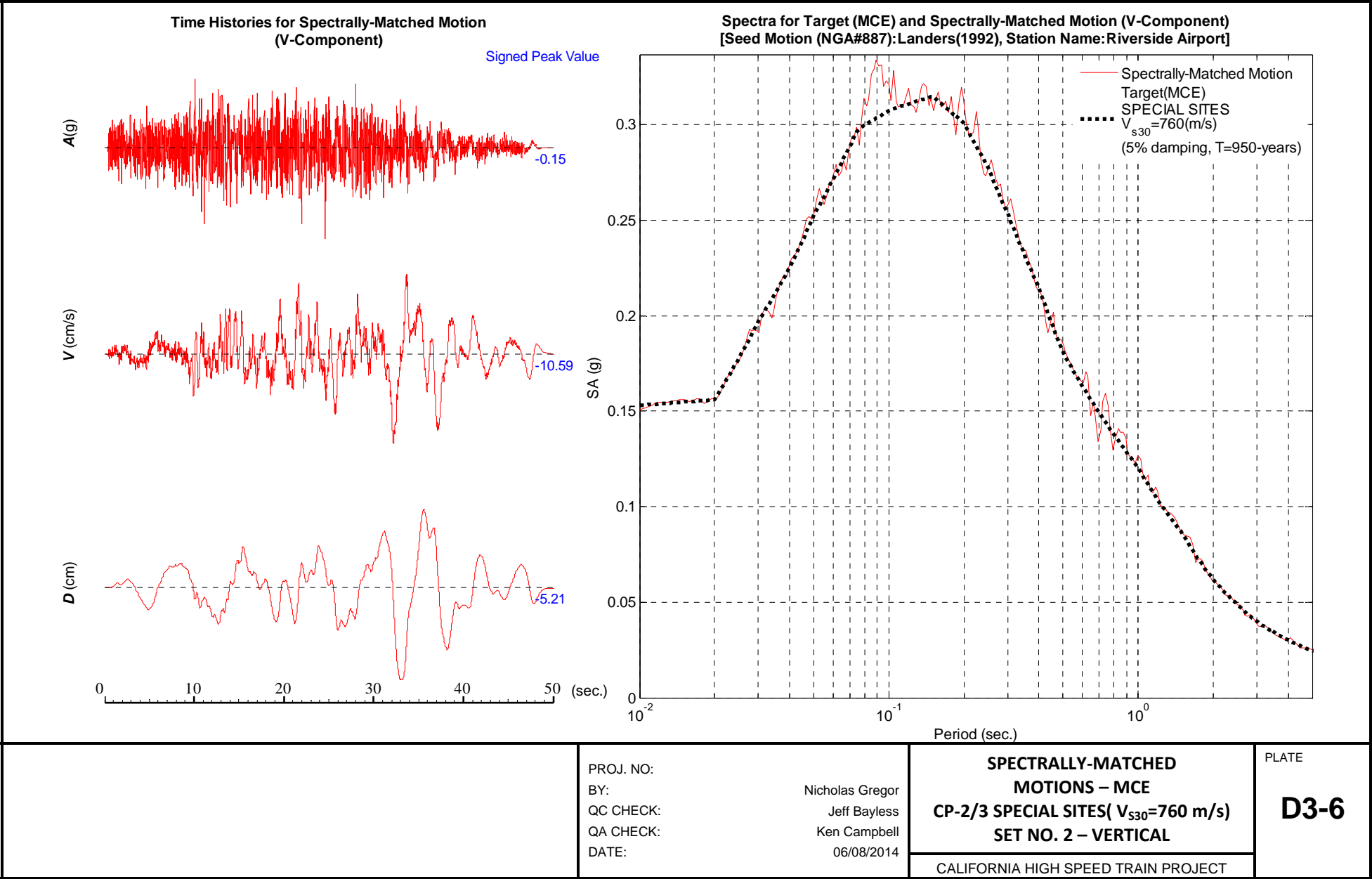


RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

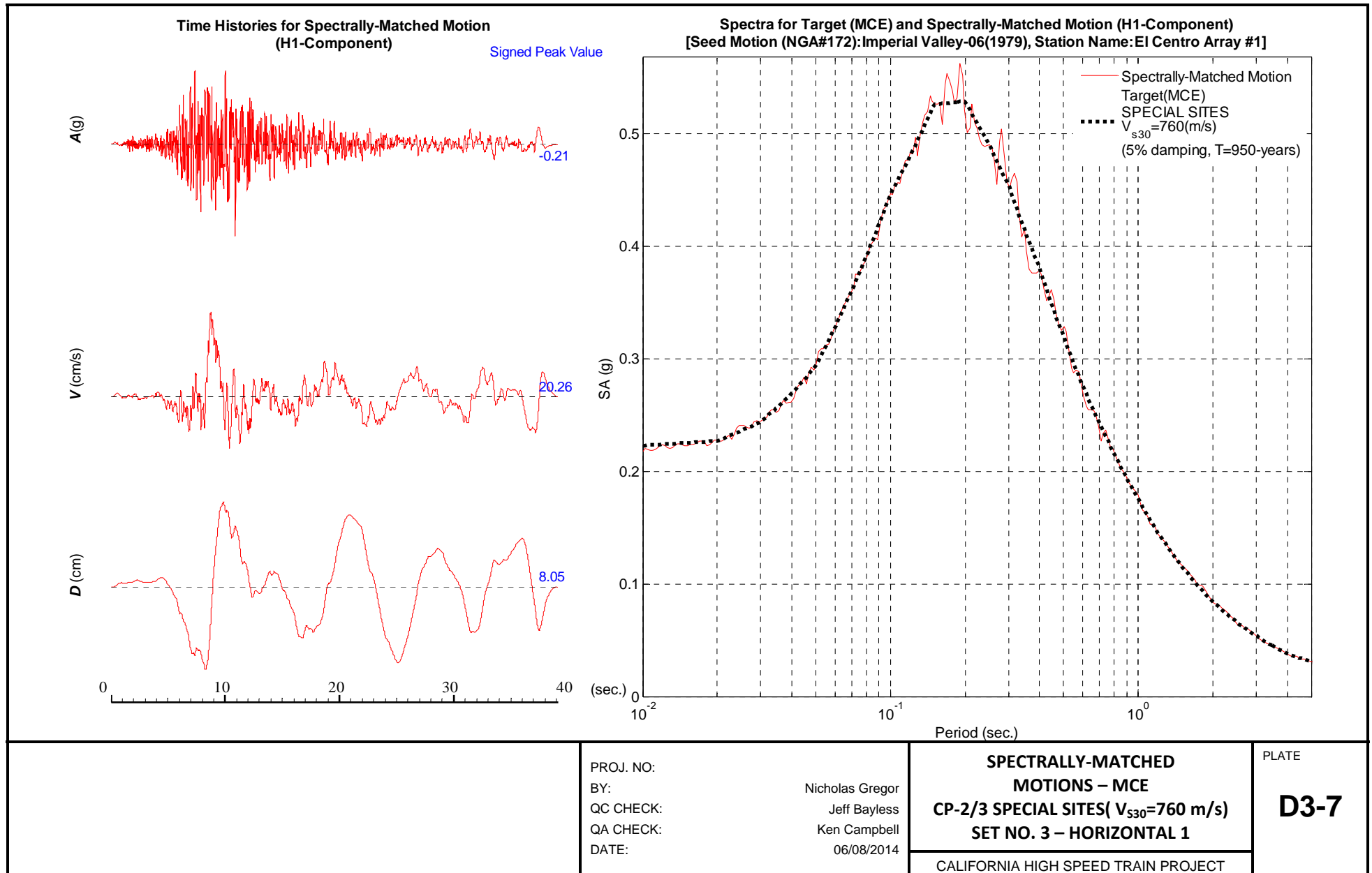




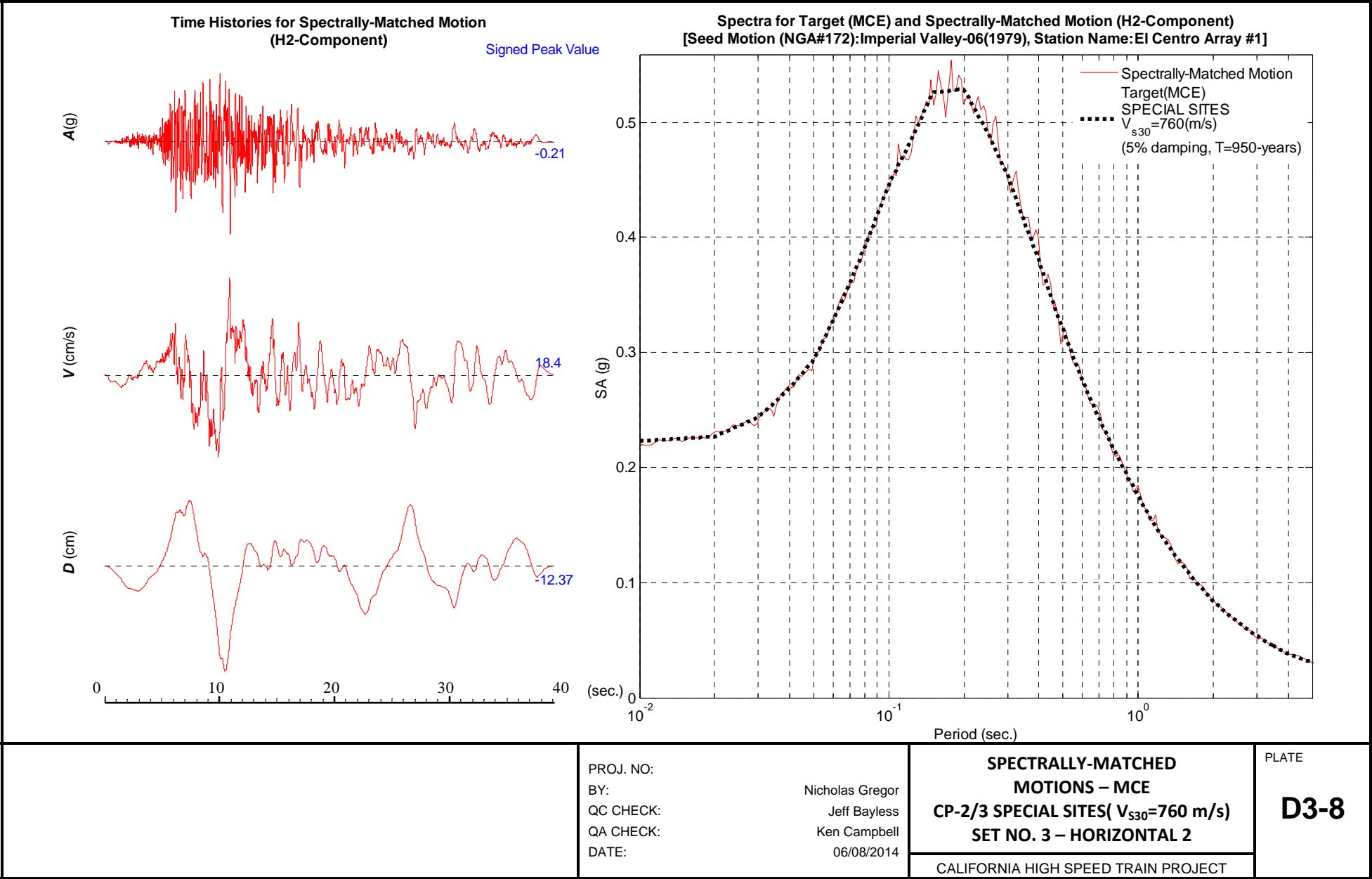




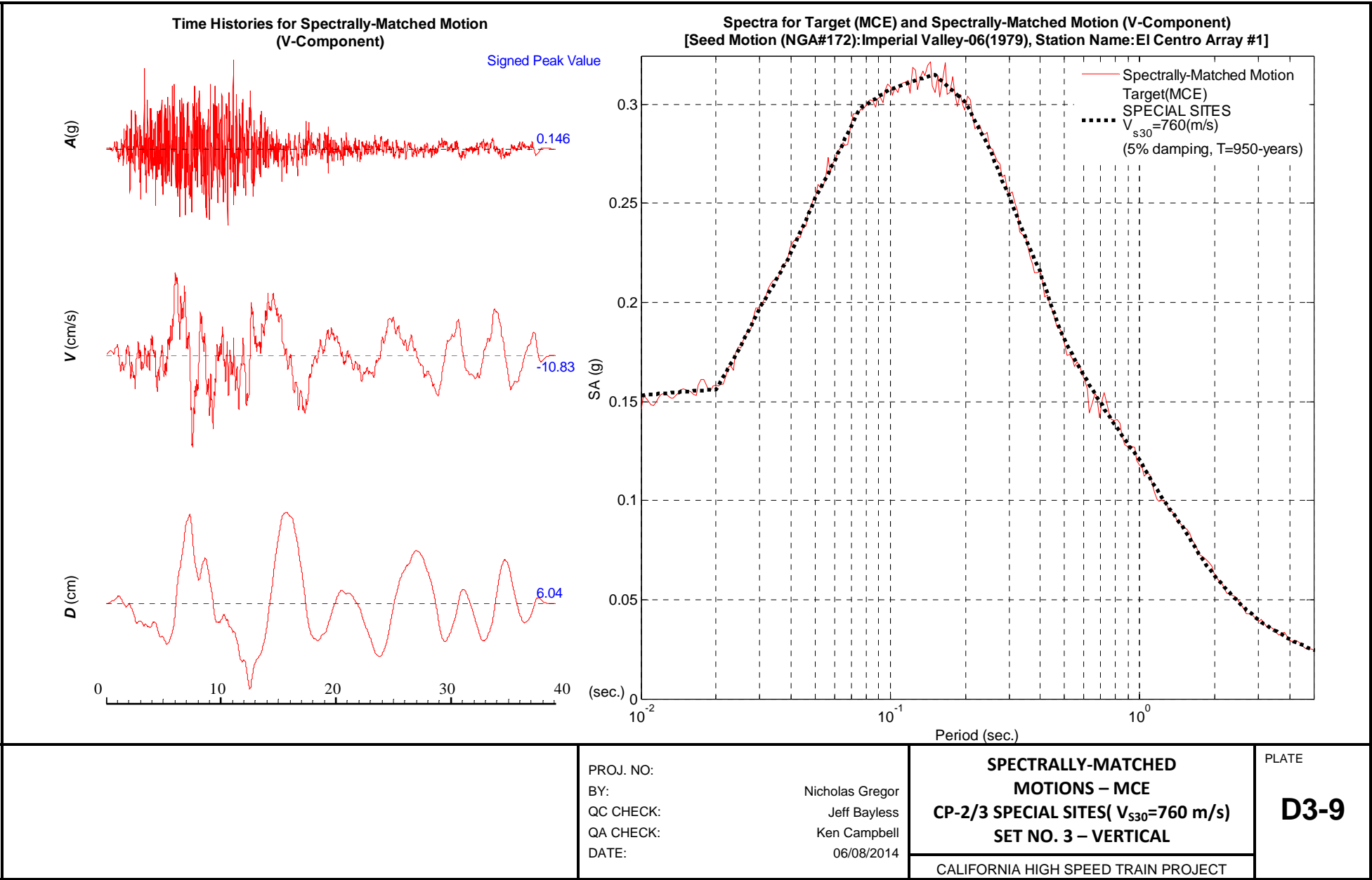
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

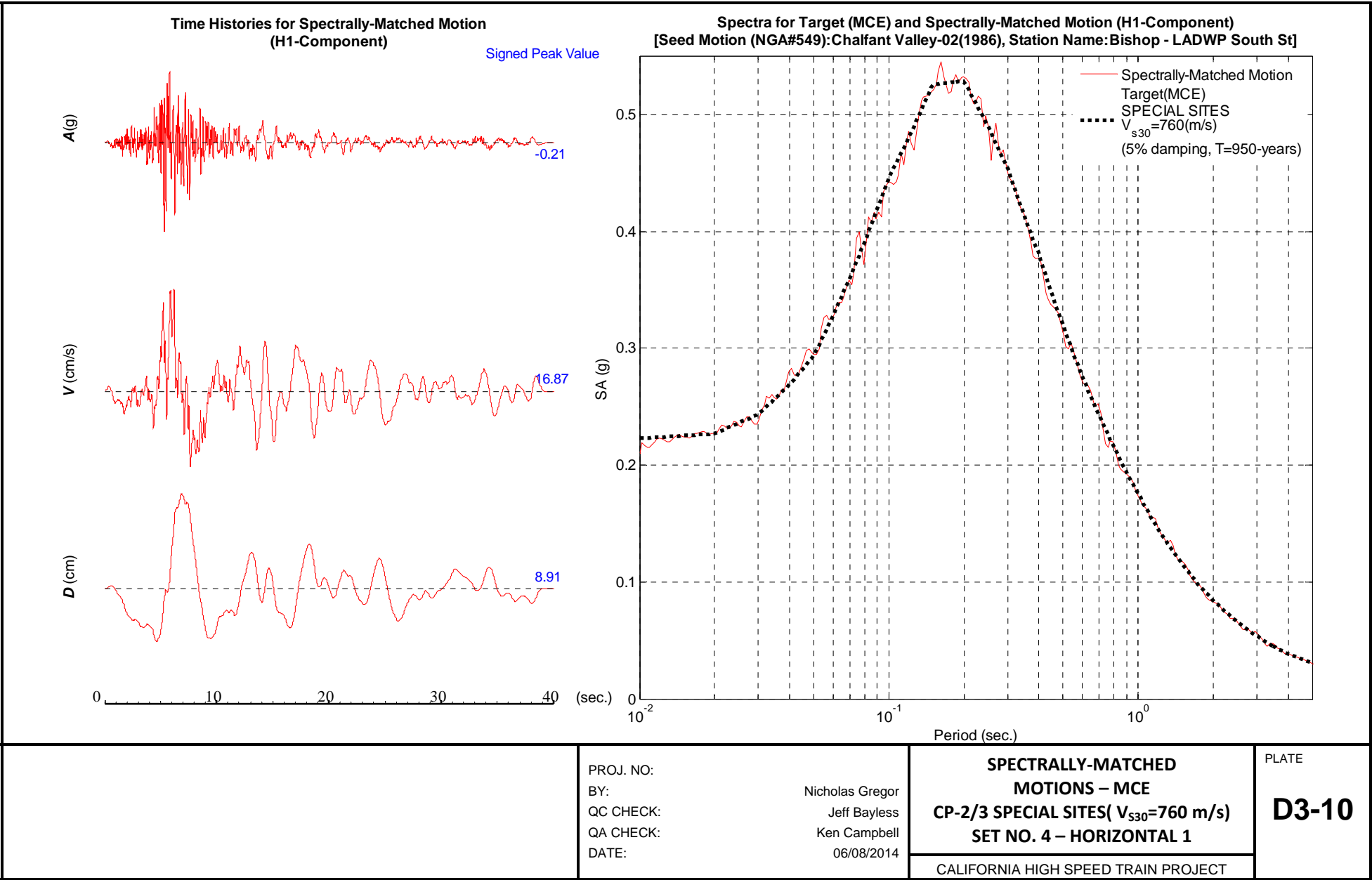




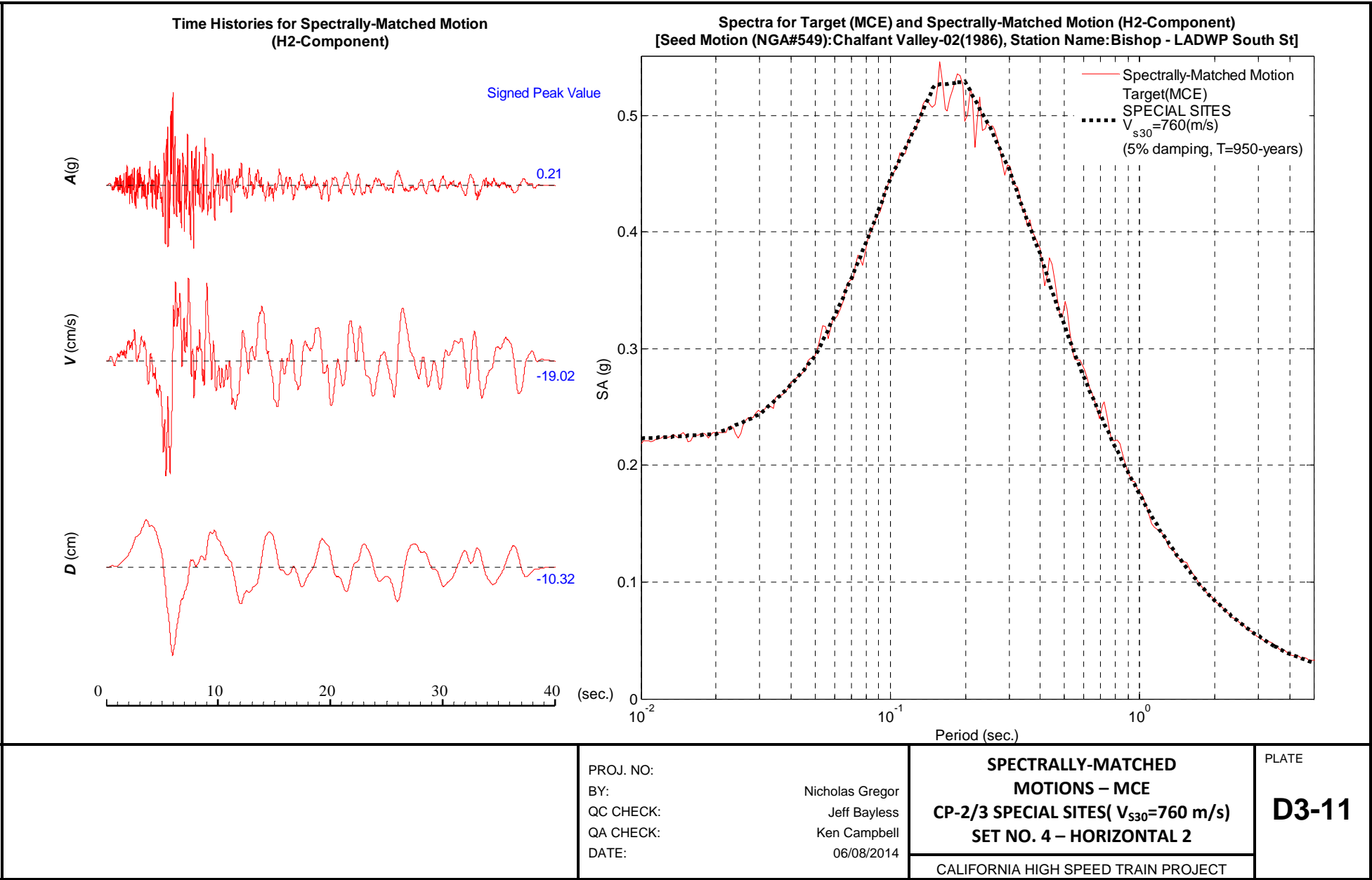


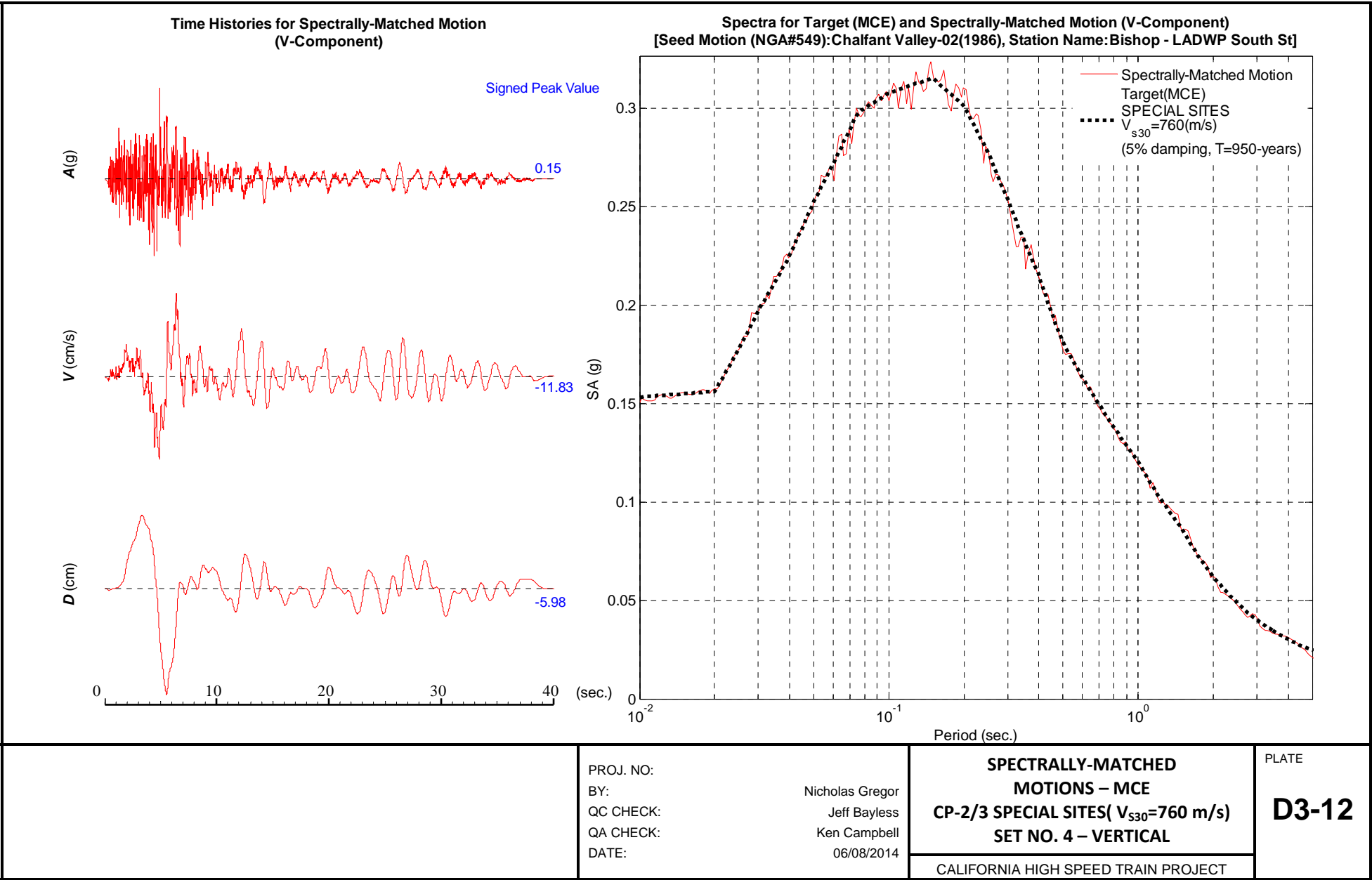
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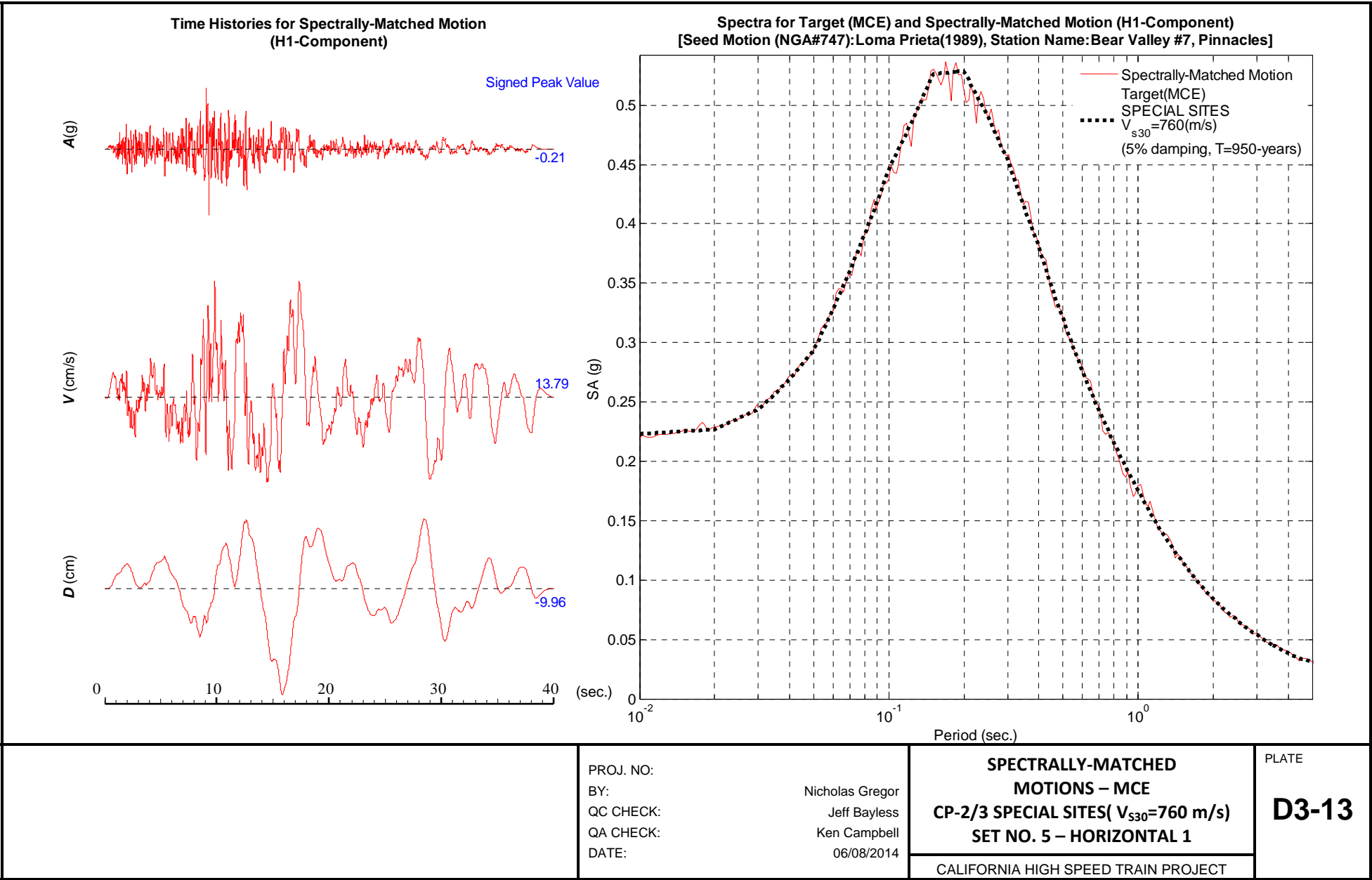




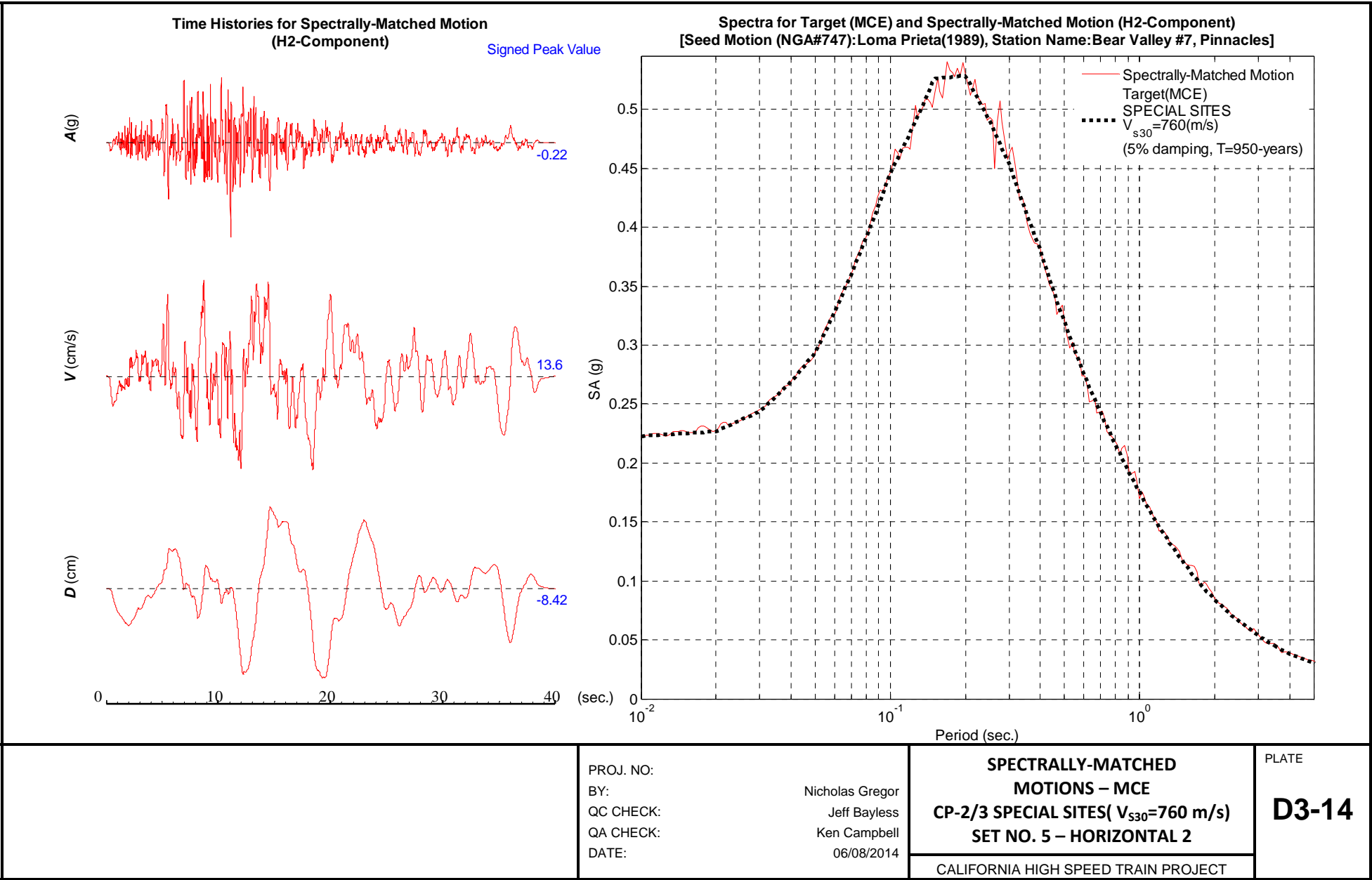
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



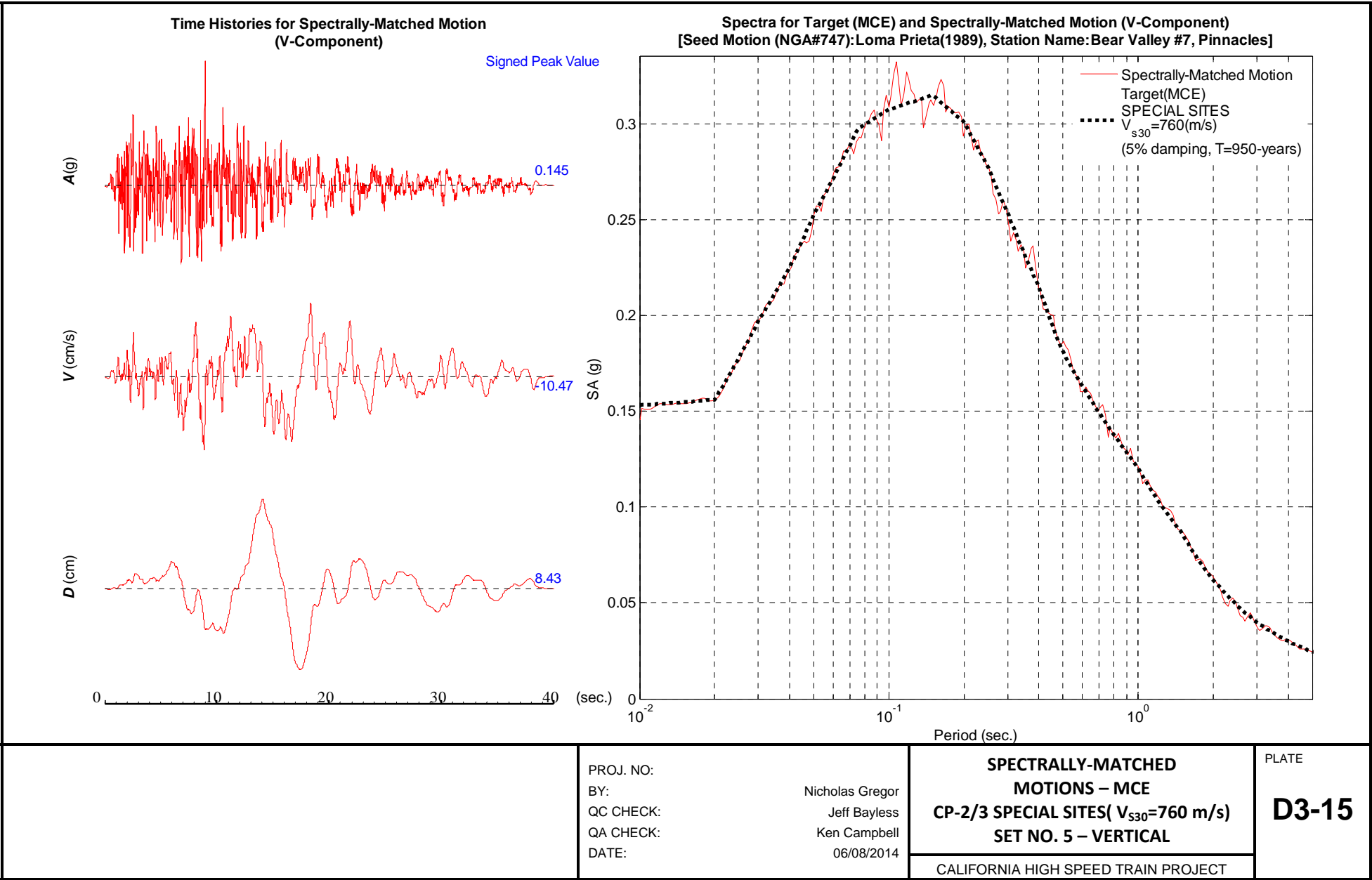




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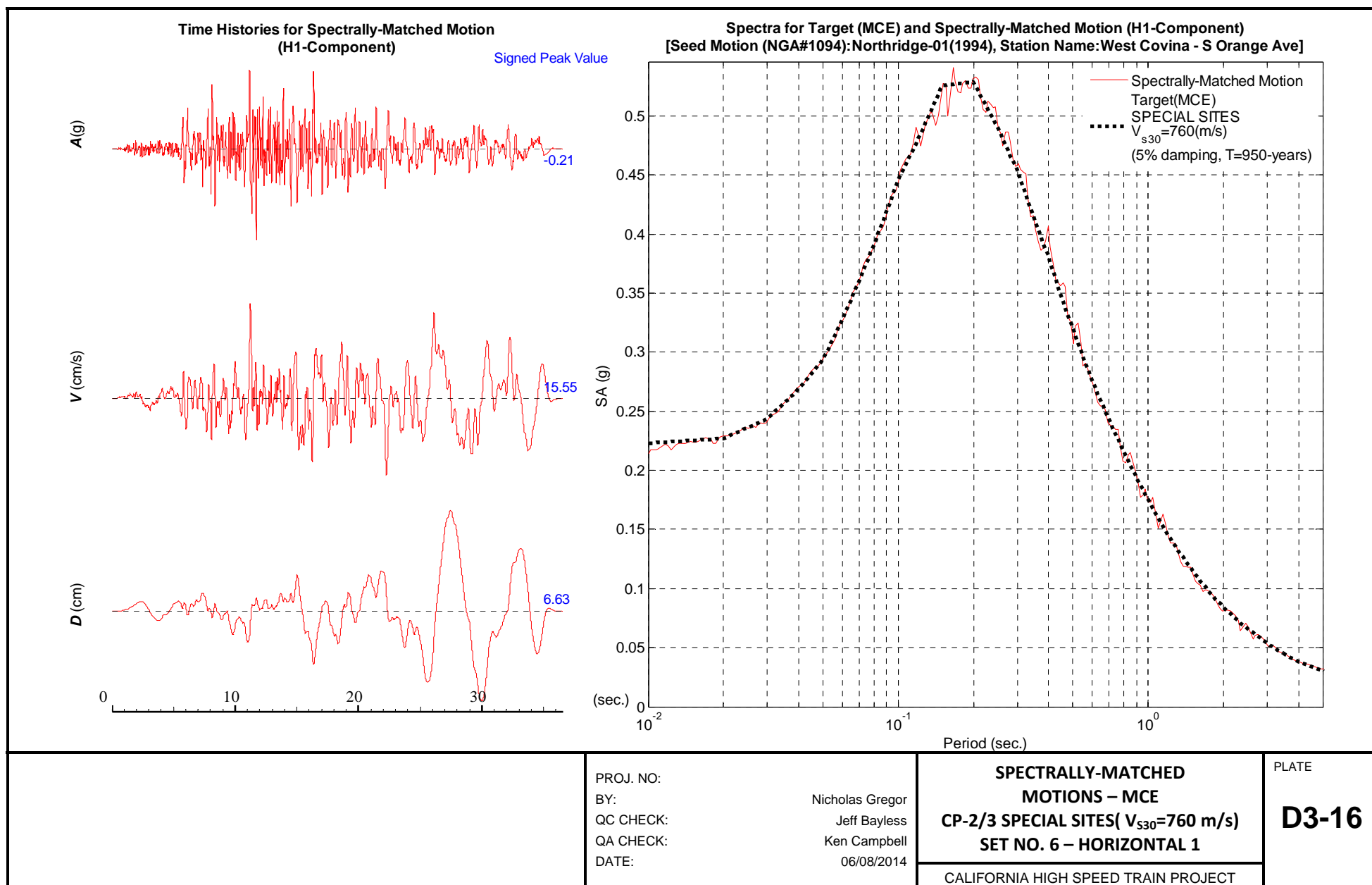
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Jeff Bayless  
Ken Campbell  
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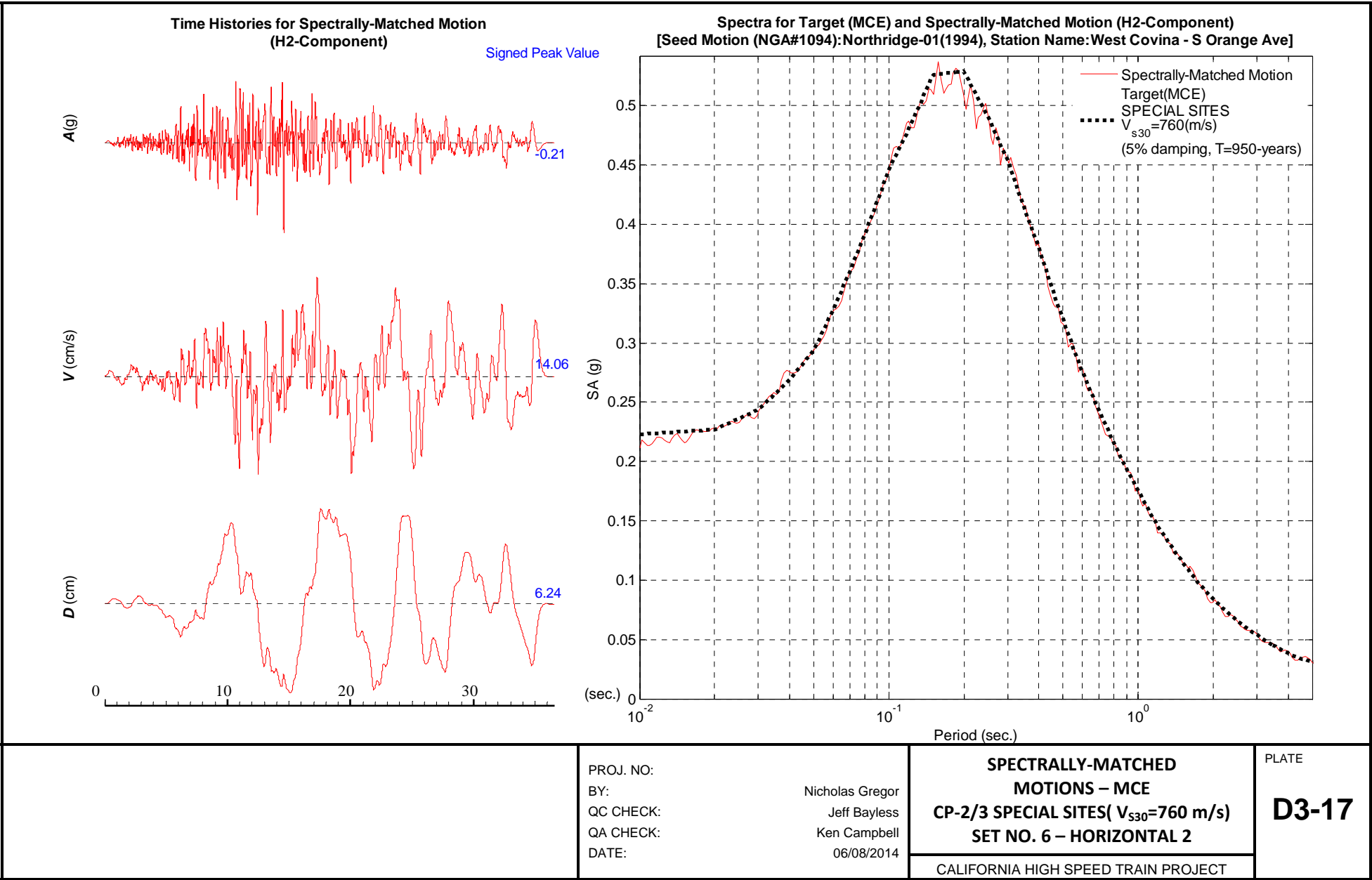
**SPECTRALLY-MATCHED  
MOTIONS – MCE  
CP-2/3 SPECIAL SITES( V<sub>s30</sub>=760 m/s)  
SET NO. 5 – VERTICAL**

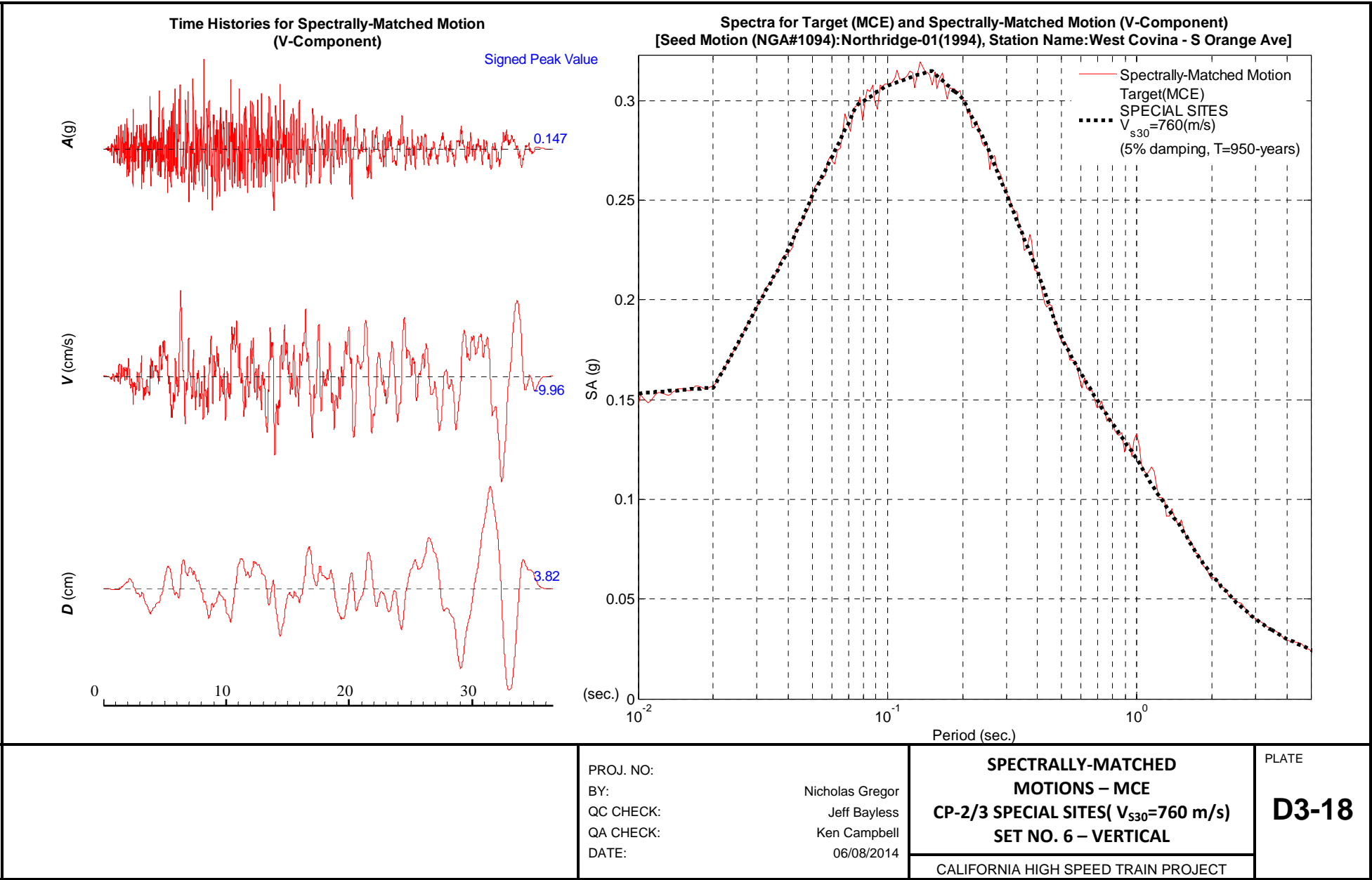
CALIFORNIA HIGH SPEED TRAIN PROJECT

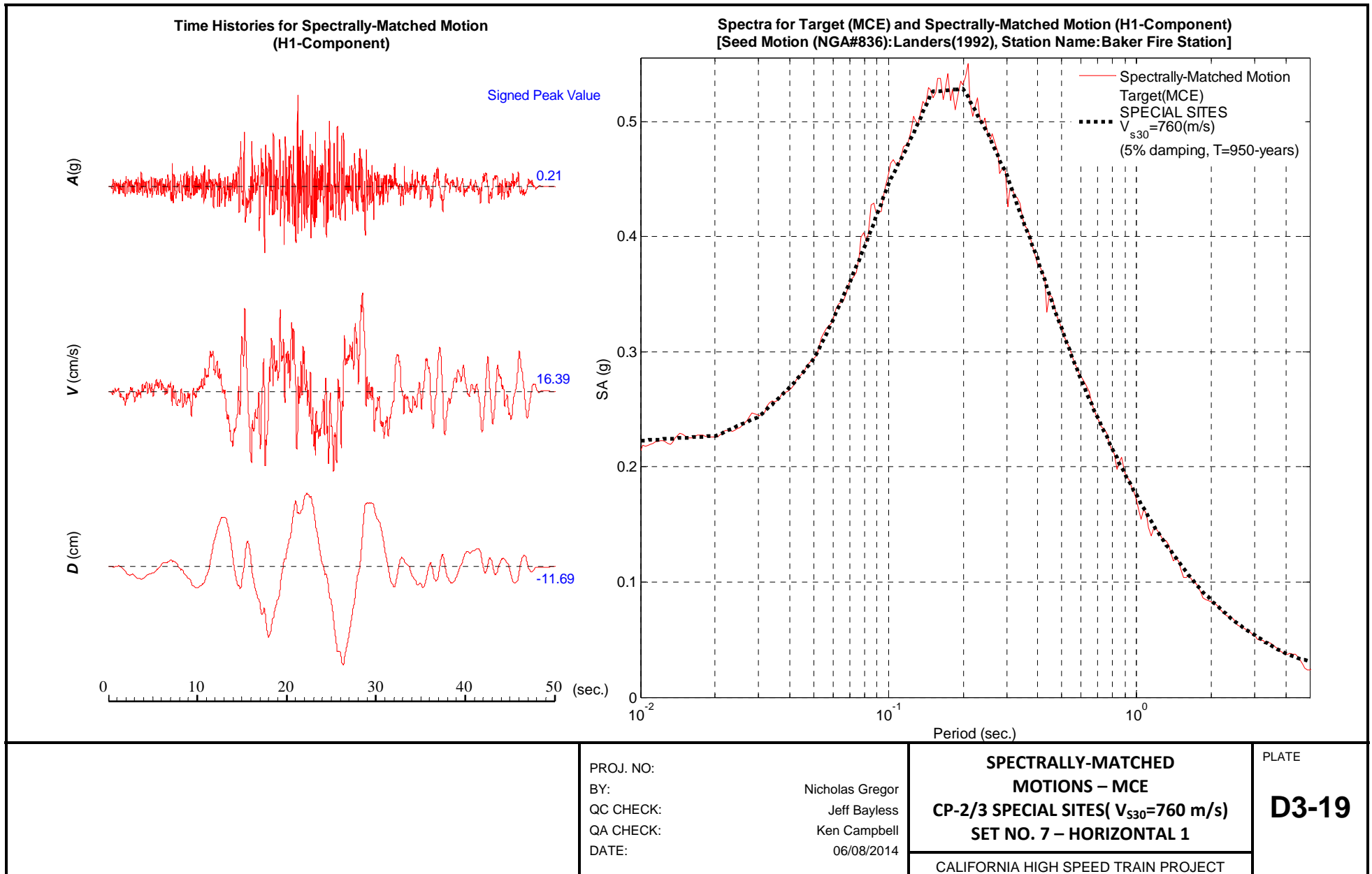
PLATE  
**D3-15**

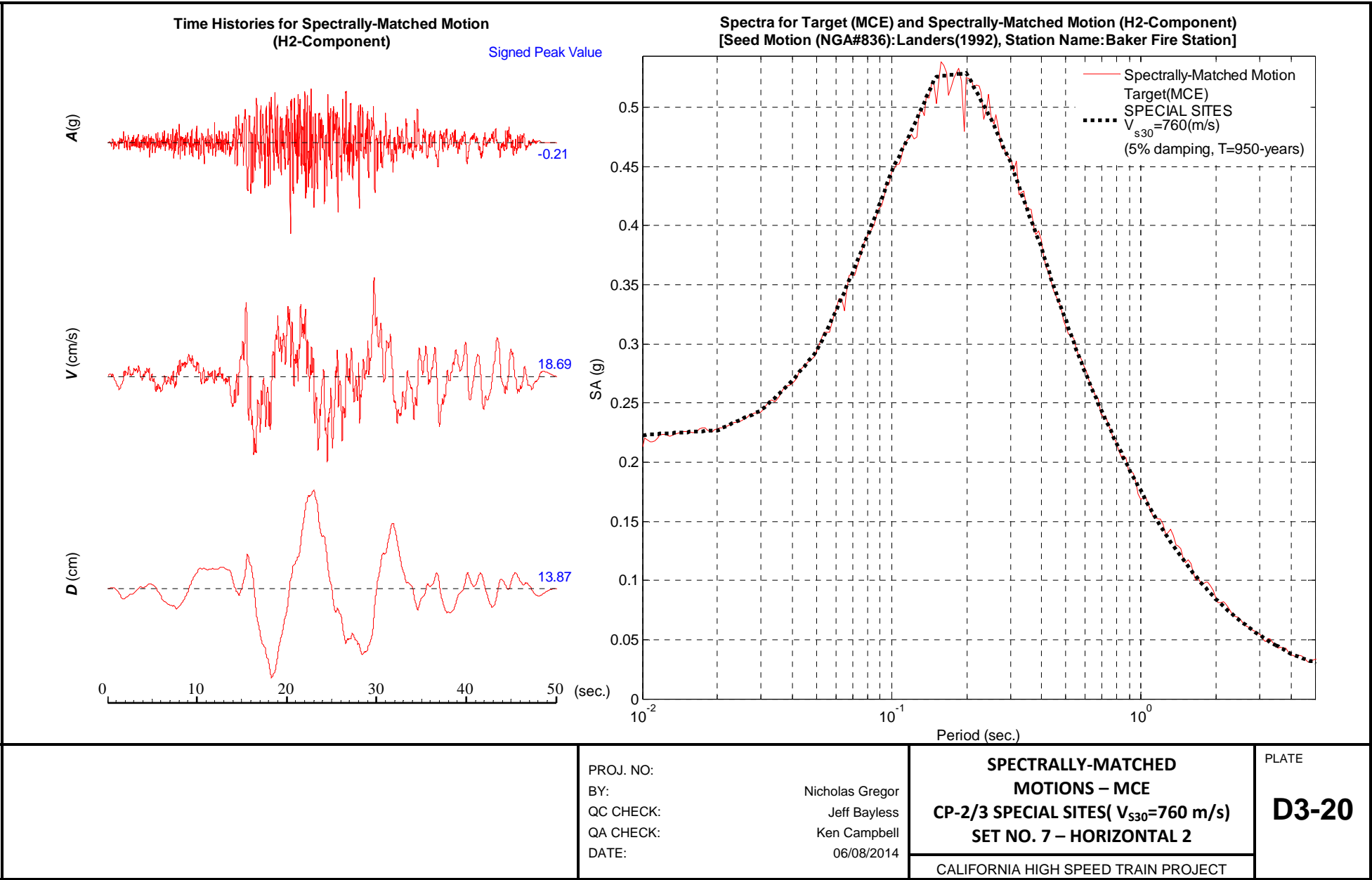




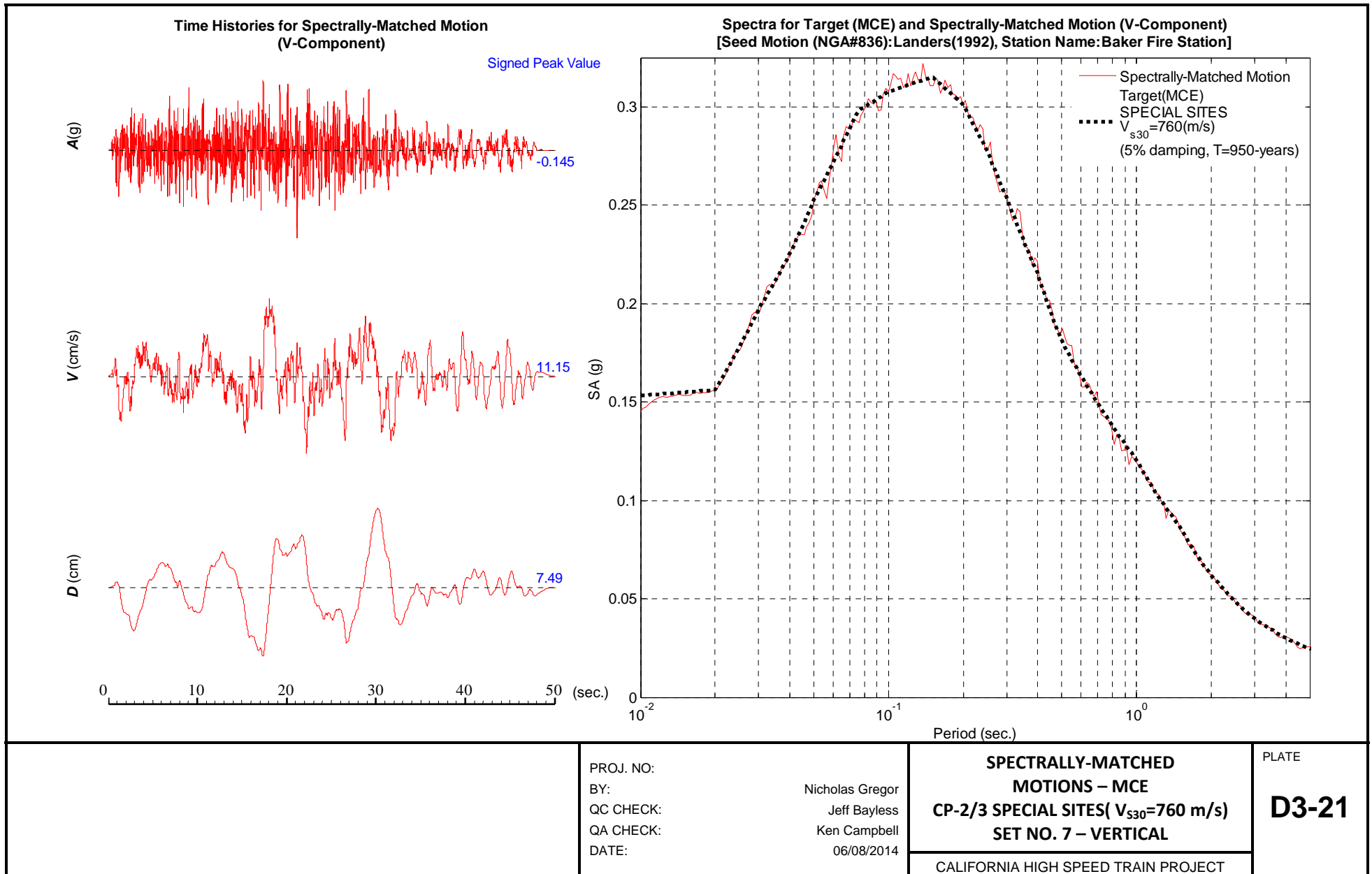








RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



**Table D.5:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **MCE Design Level for CP-2/3 SPECIAL SITES ( $V_{S30}=1220$  m/s)**

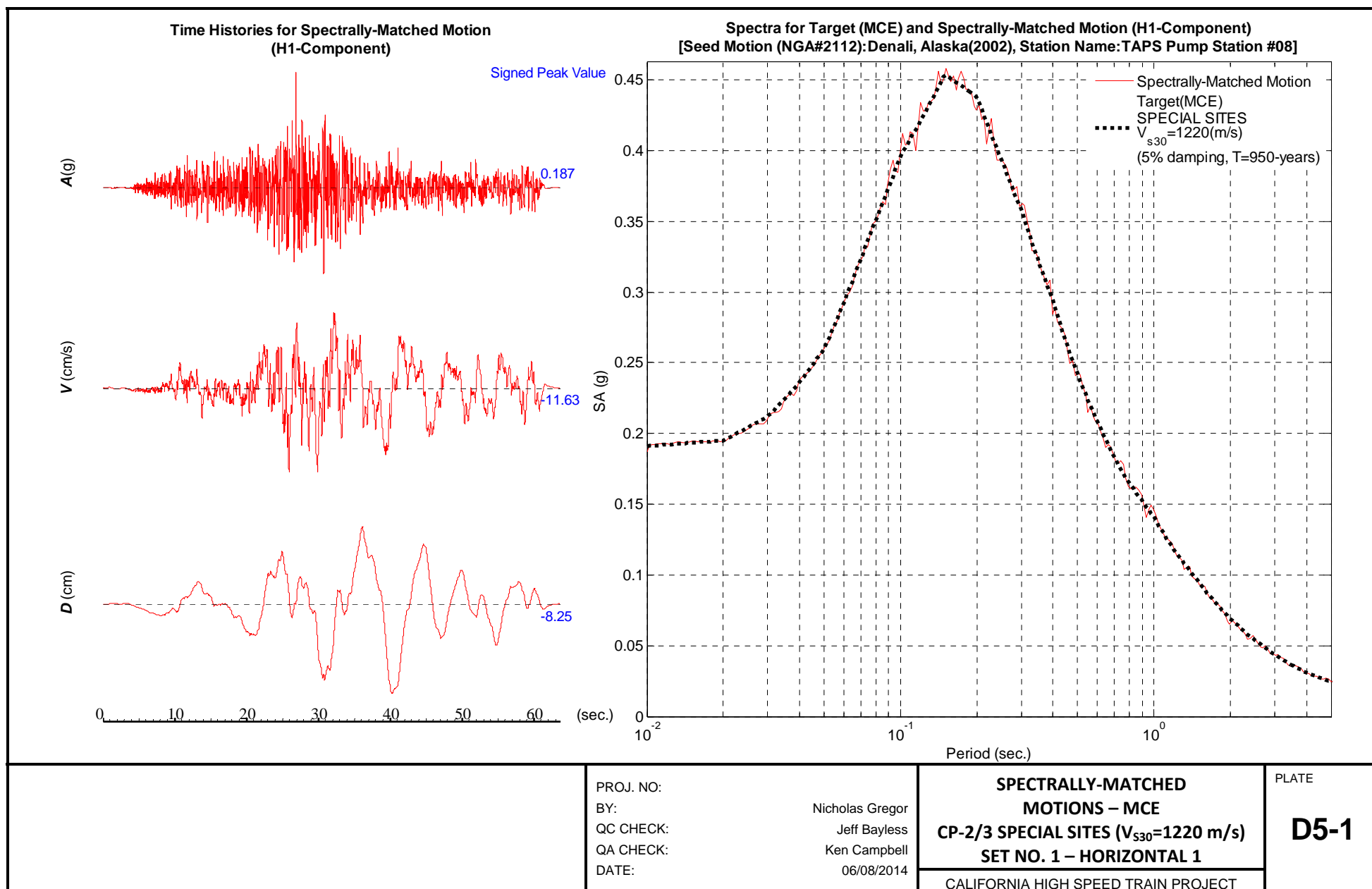
Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA	PGV	PGD	PGA	PGV	PGD	PGA	PGV	PGD
							H1 (g)	H1 (cm/s)	H1 (cm)	H2 (g)	H2 (cm/s)	H2 (cm)	V (g)	V (cm/s)	V (cm)
1	2112	Denali, Alaska	2002	TAPS Pump Station #08	7.90	104.94	0.188	11.639	8.251	0.184	12.154	9.153	0.134	11.781	9.769
2	887	Landers	1992	Riverside Airport	7.28	96.00	0.185	10.370	6.810	0.189	10.224	5.808	0.136	9.118	4.625
3	172	Imperial Valley-06	1979	El Centro Array #1	6.53	21.68	0.183	16.341	6.446	0.188	14.472	9.477	0.135	9.282	5.502
4	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.183	13.180	7.062	0.179	15.292	8.235	0.136	10.757	5.626
5	747	Loma Prieta	1989	Bear Valley #7, Pinnacles	6.93	69.38	0.185	10.838	7.584	0.190	10.770	6.625	0.132	9.370	7.860
6	1094	Northridge-01	1994	West Covina - S Orange Ave	6.69	51.71	0.179	12.034	5.208	0.181	11.067	4.791	0.134	8.641	3.365
7	836	Landers	1992	Baker Fire Station	7.28	87.94	0.189	12.558	8.946	0.184	14.525	10.136	0.131	9.632	6.571

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DATE:

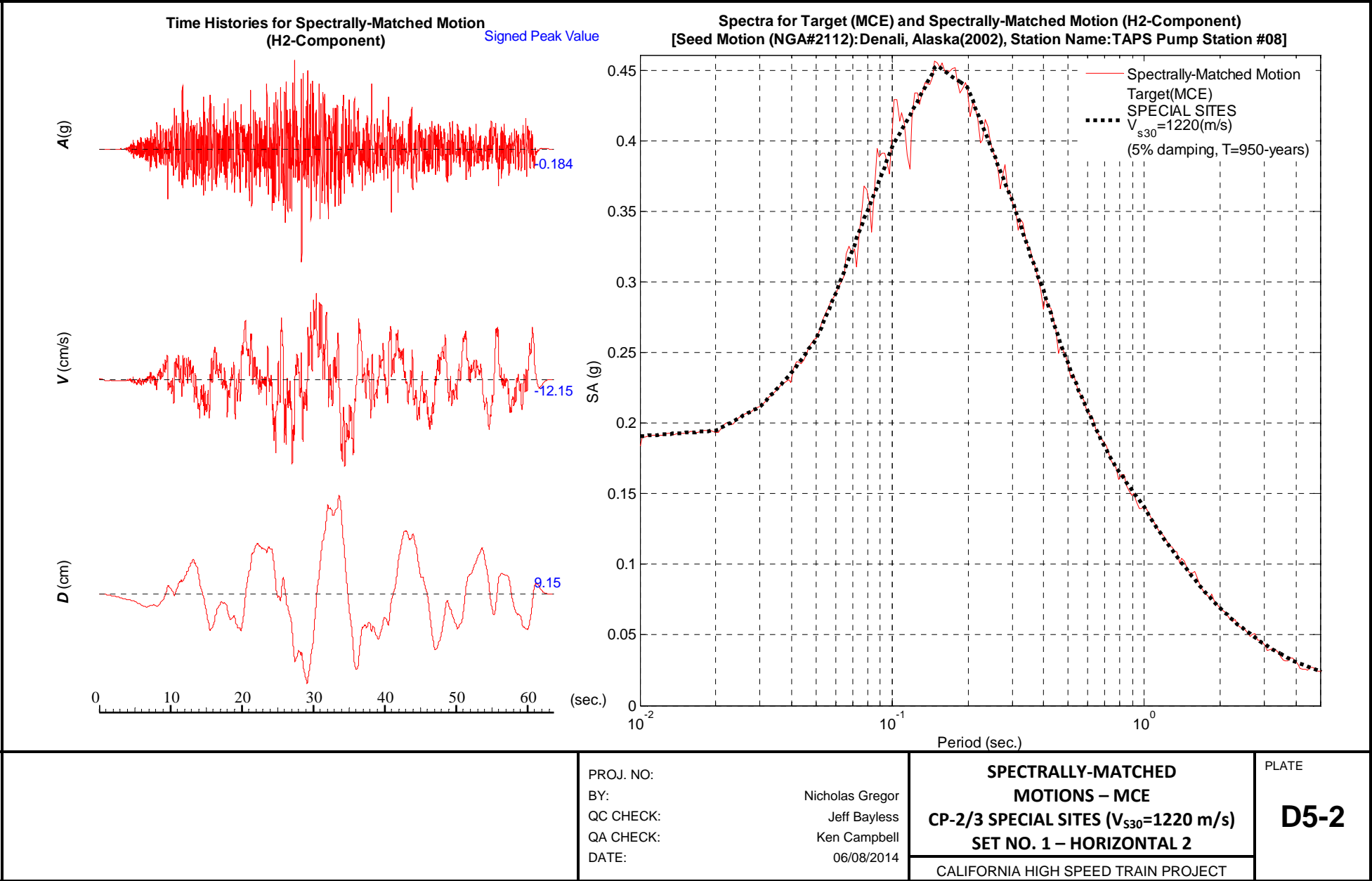
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Ken Campbell  
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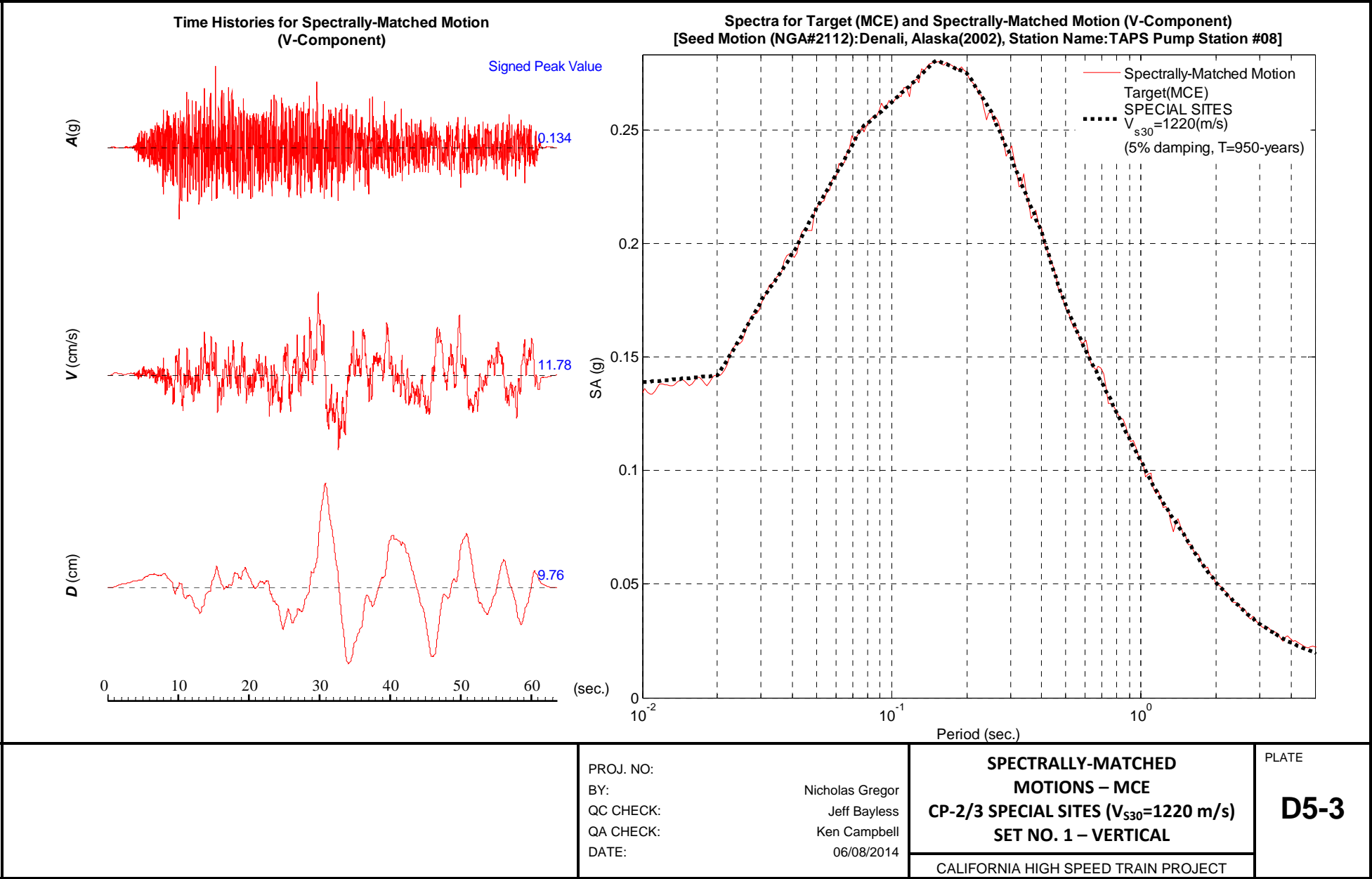
**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
MCE – CP-2/3 SPECIAL SITES ( $V_{S30}=1220$  m/s)**  
CALIFORNIA HIGH SPEED TRAIN PROJECT

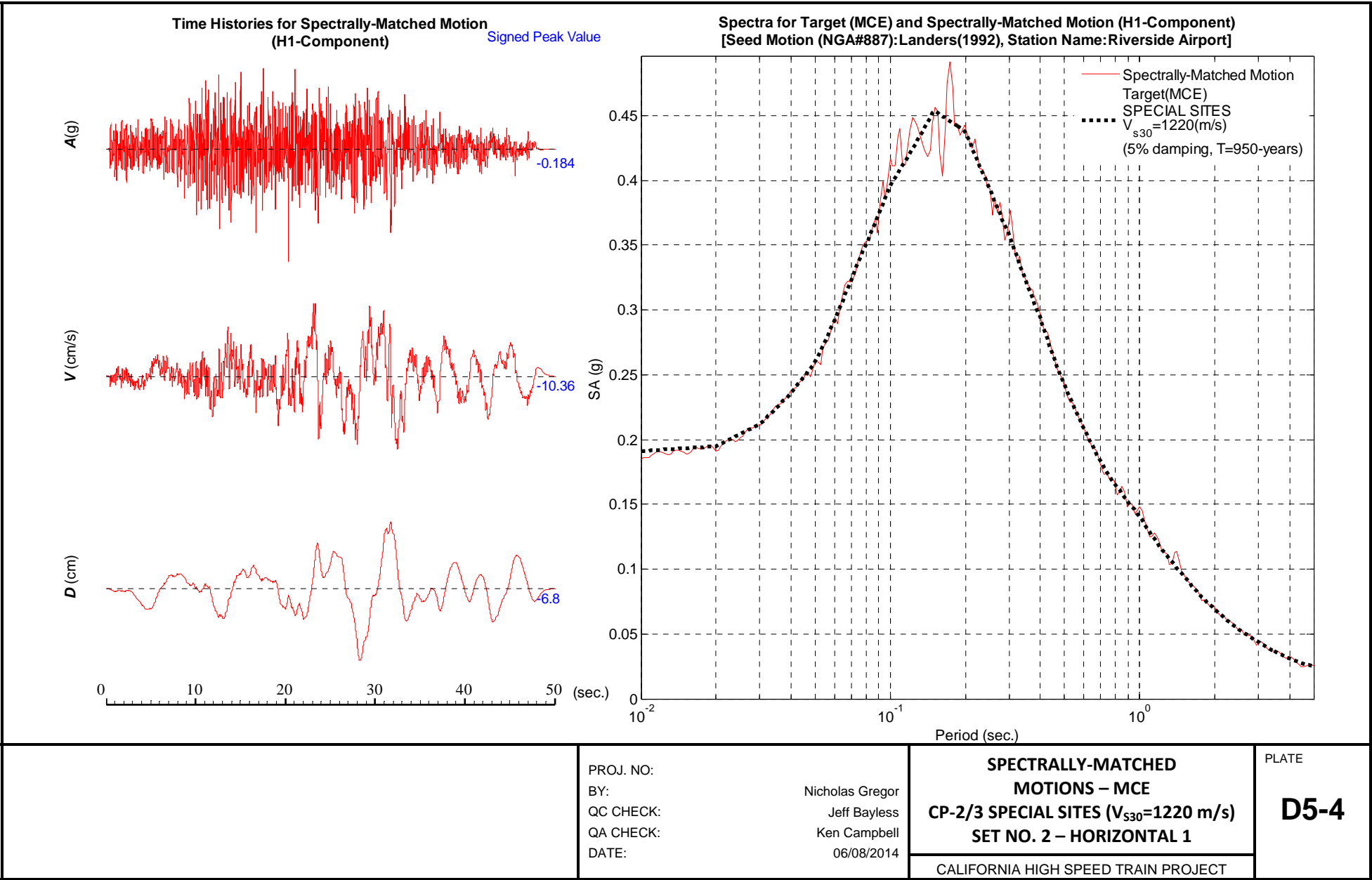
PLATE  
**D5-0**

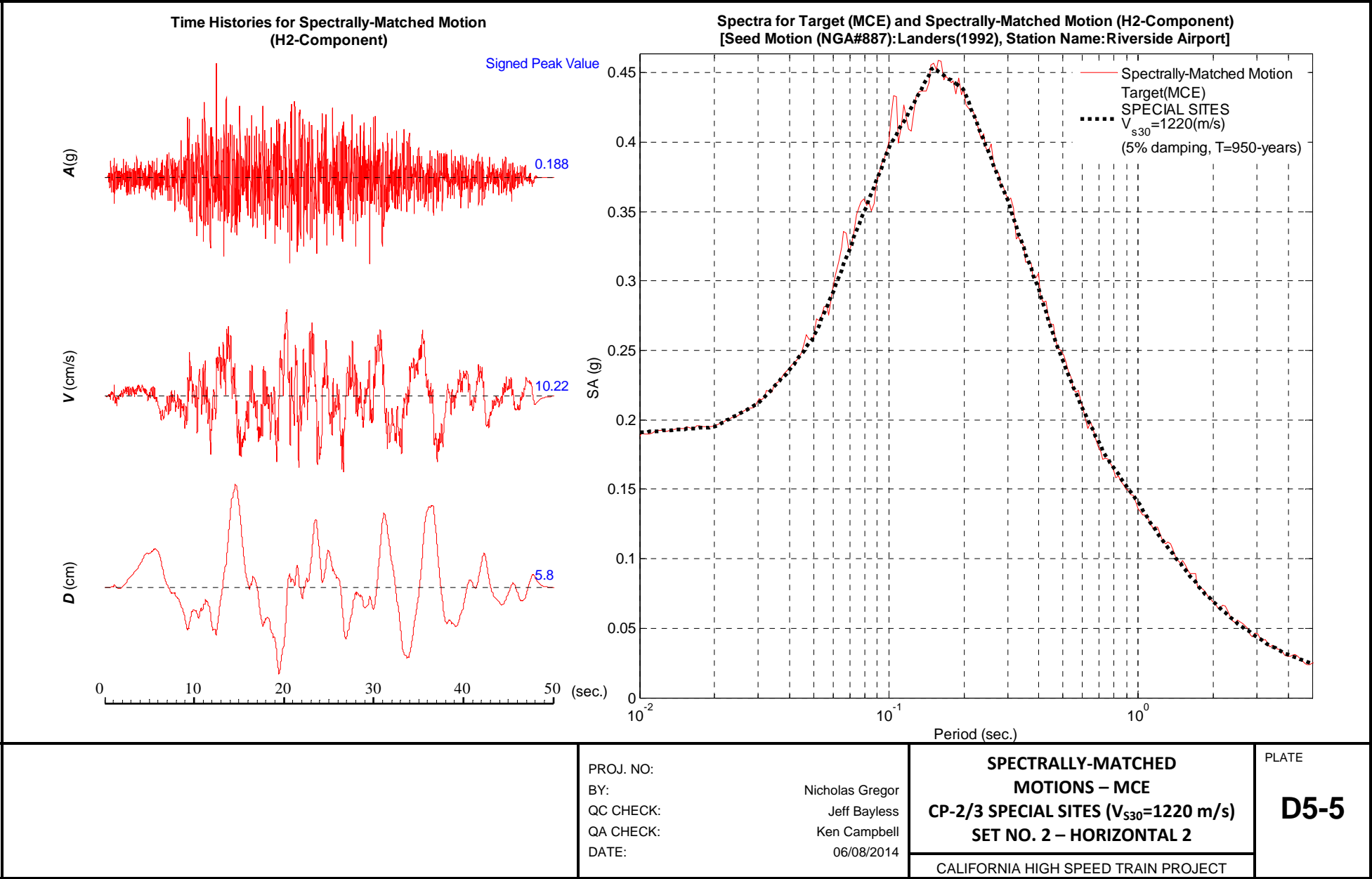




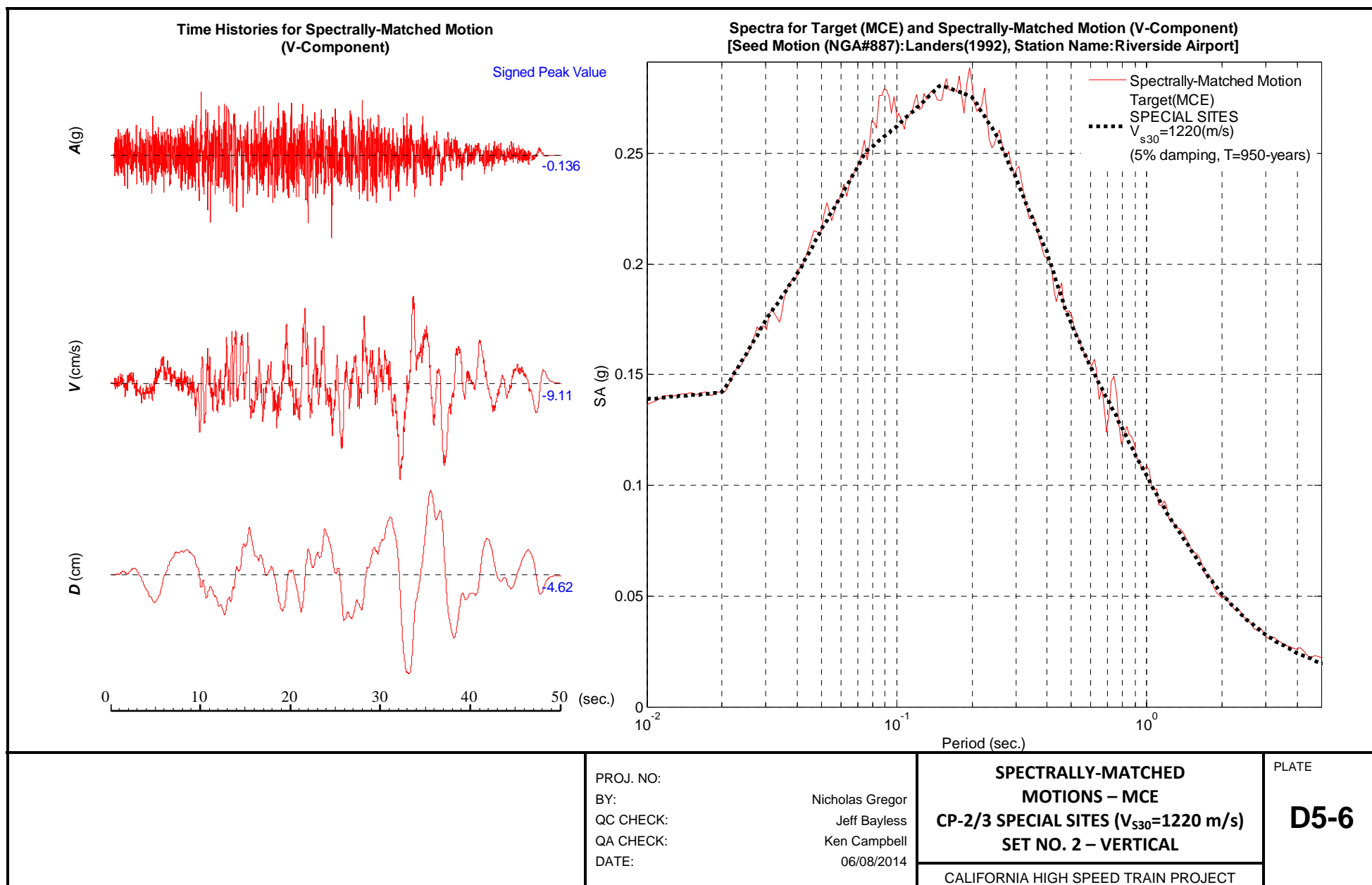


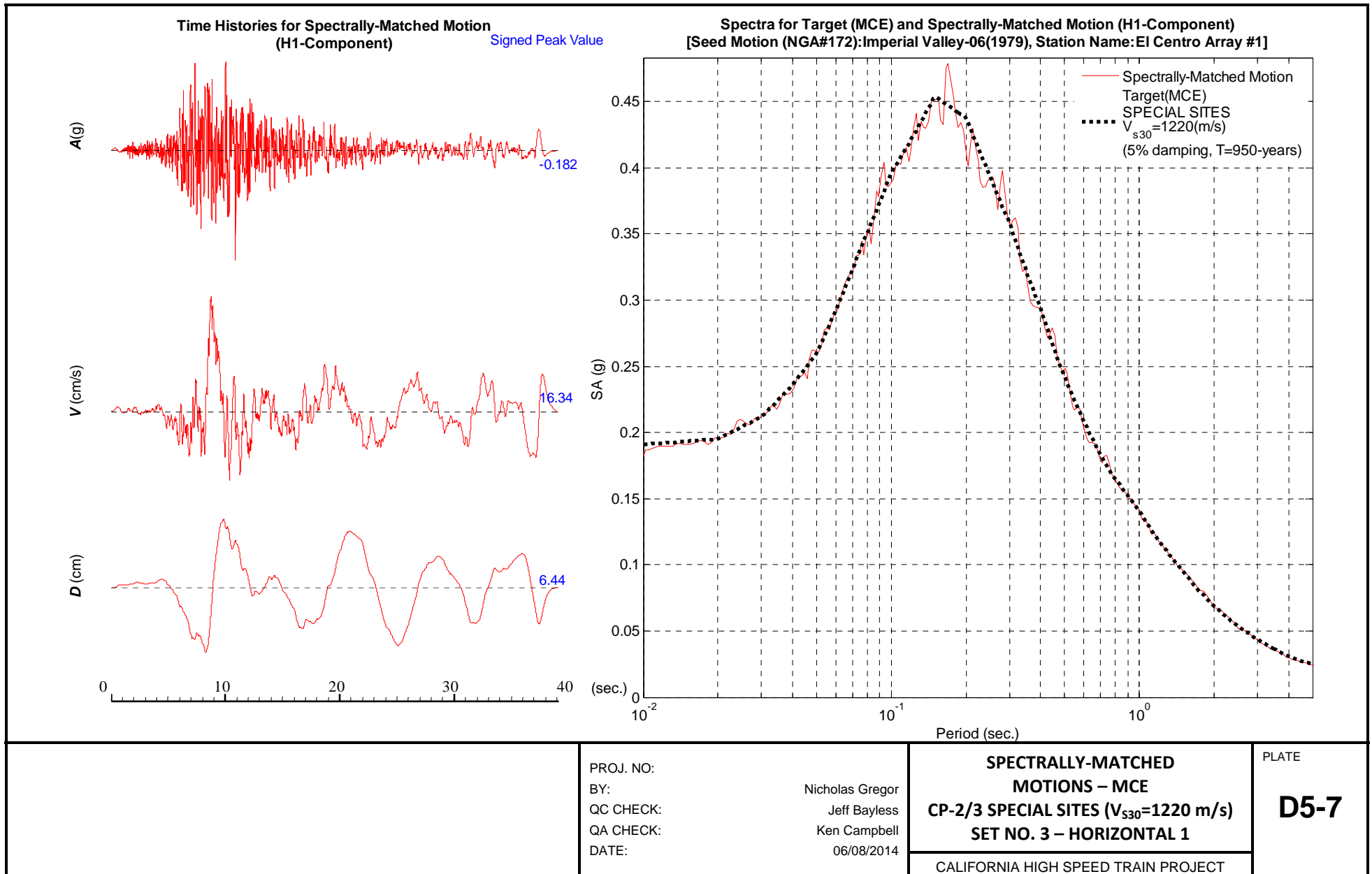


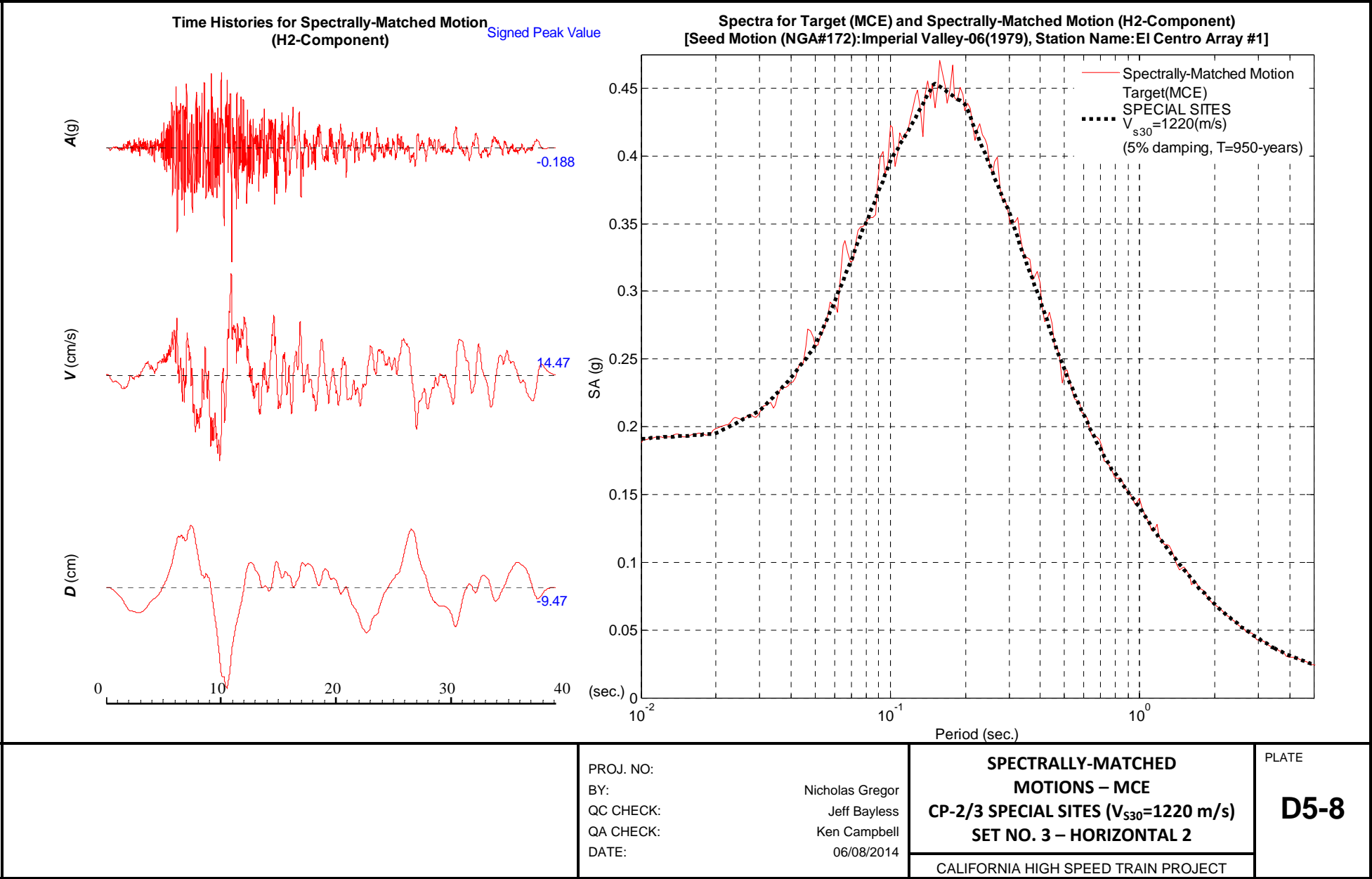


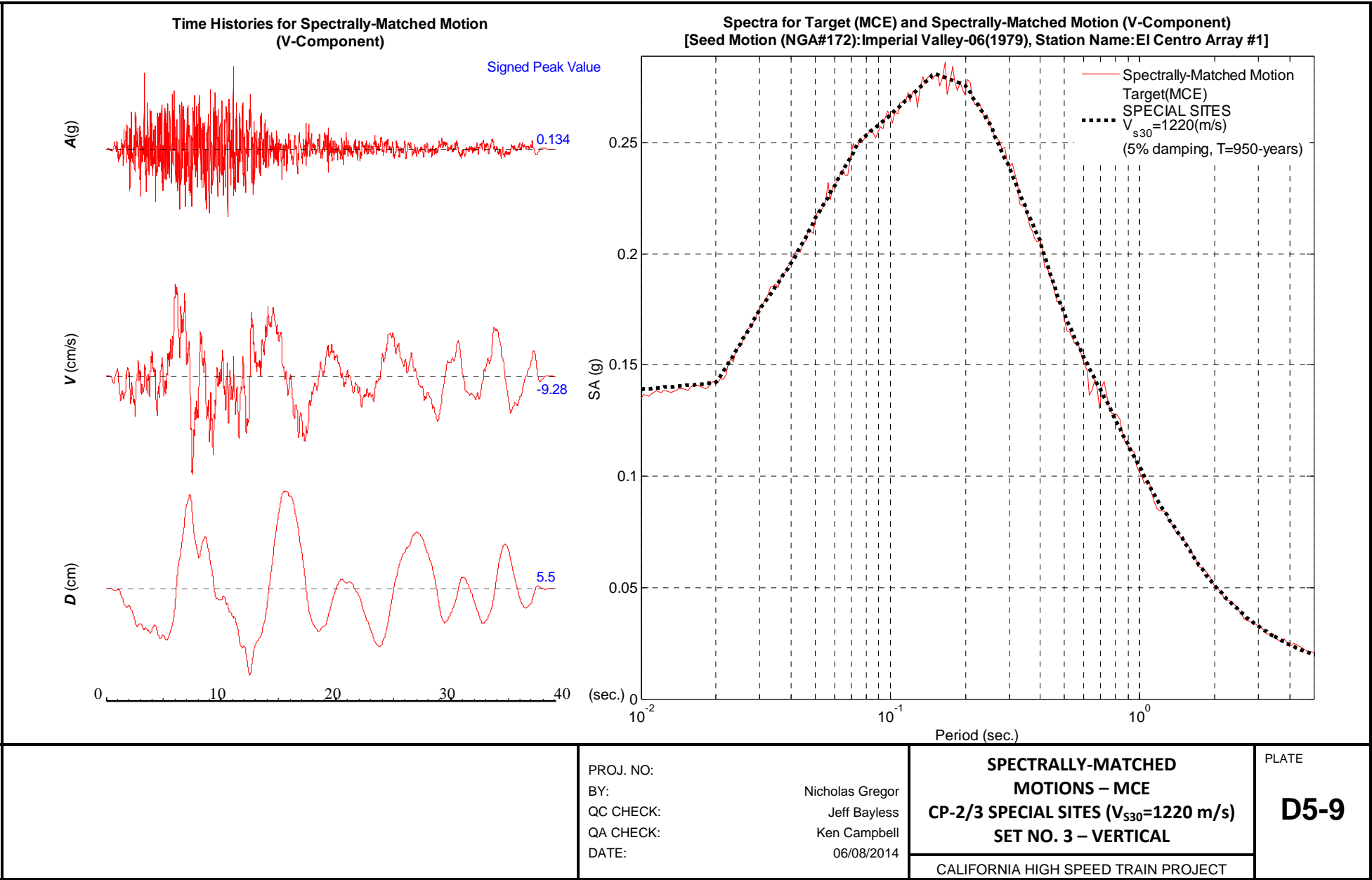


RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

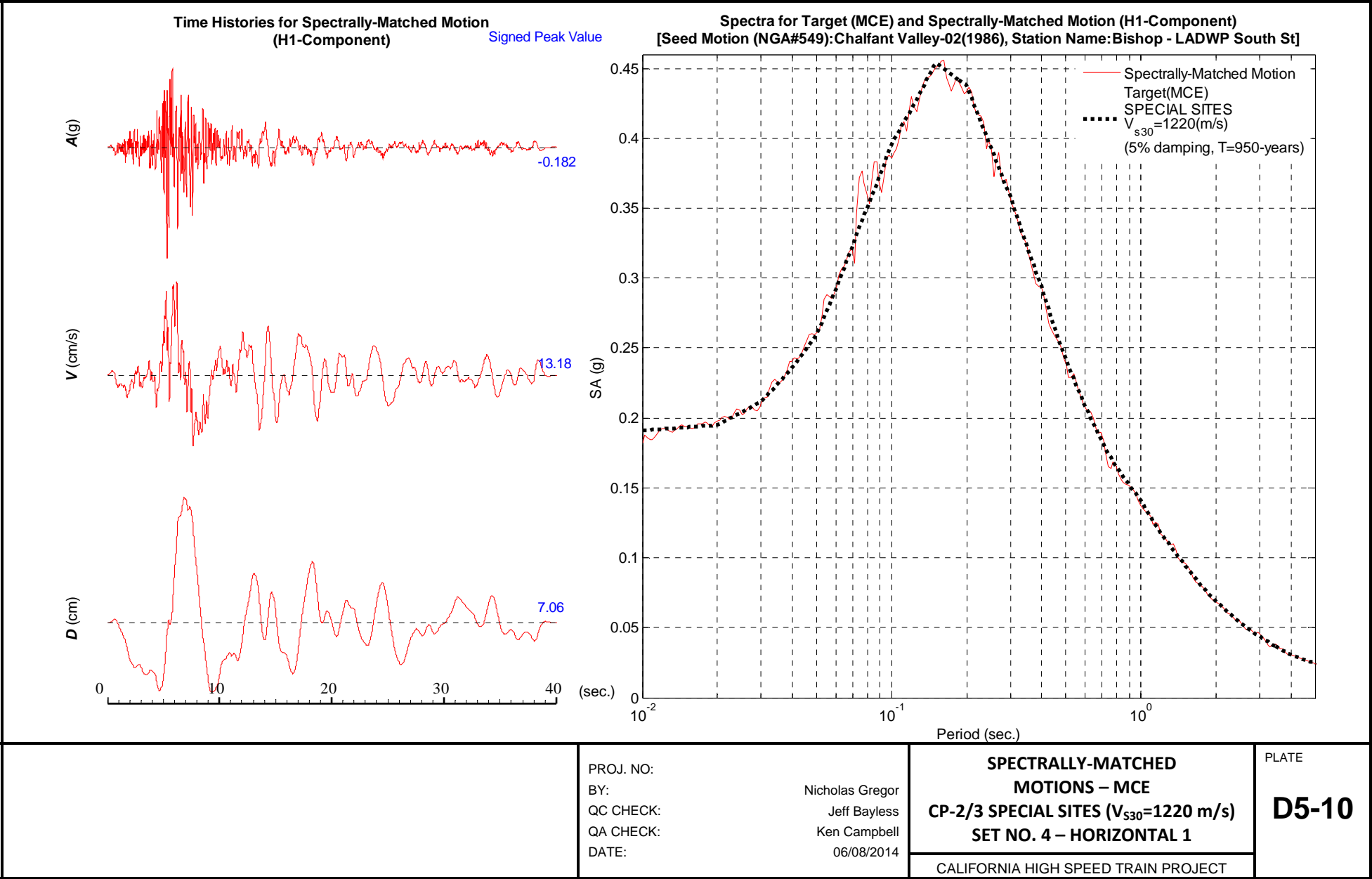


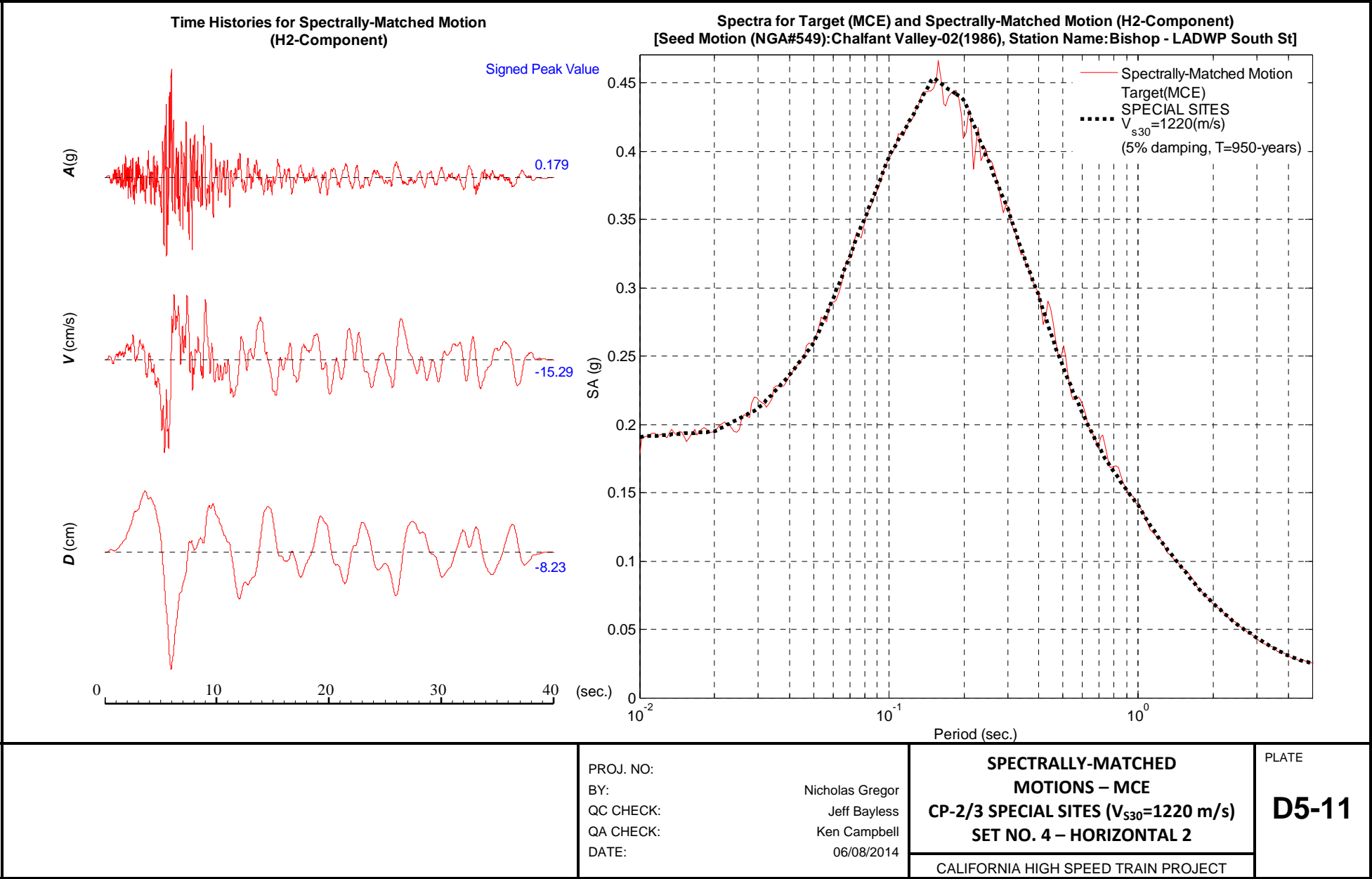




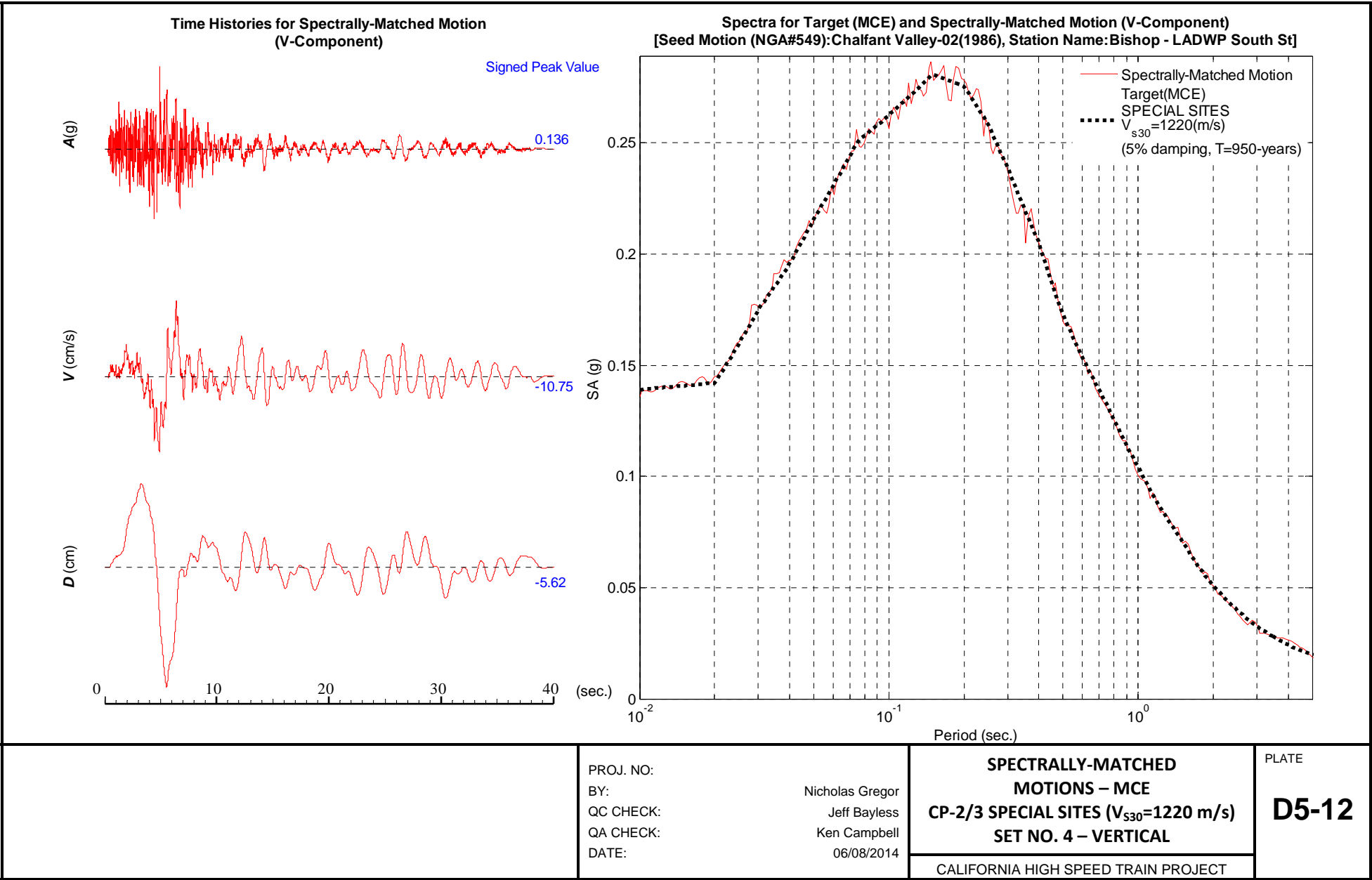




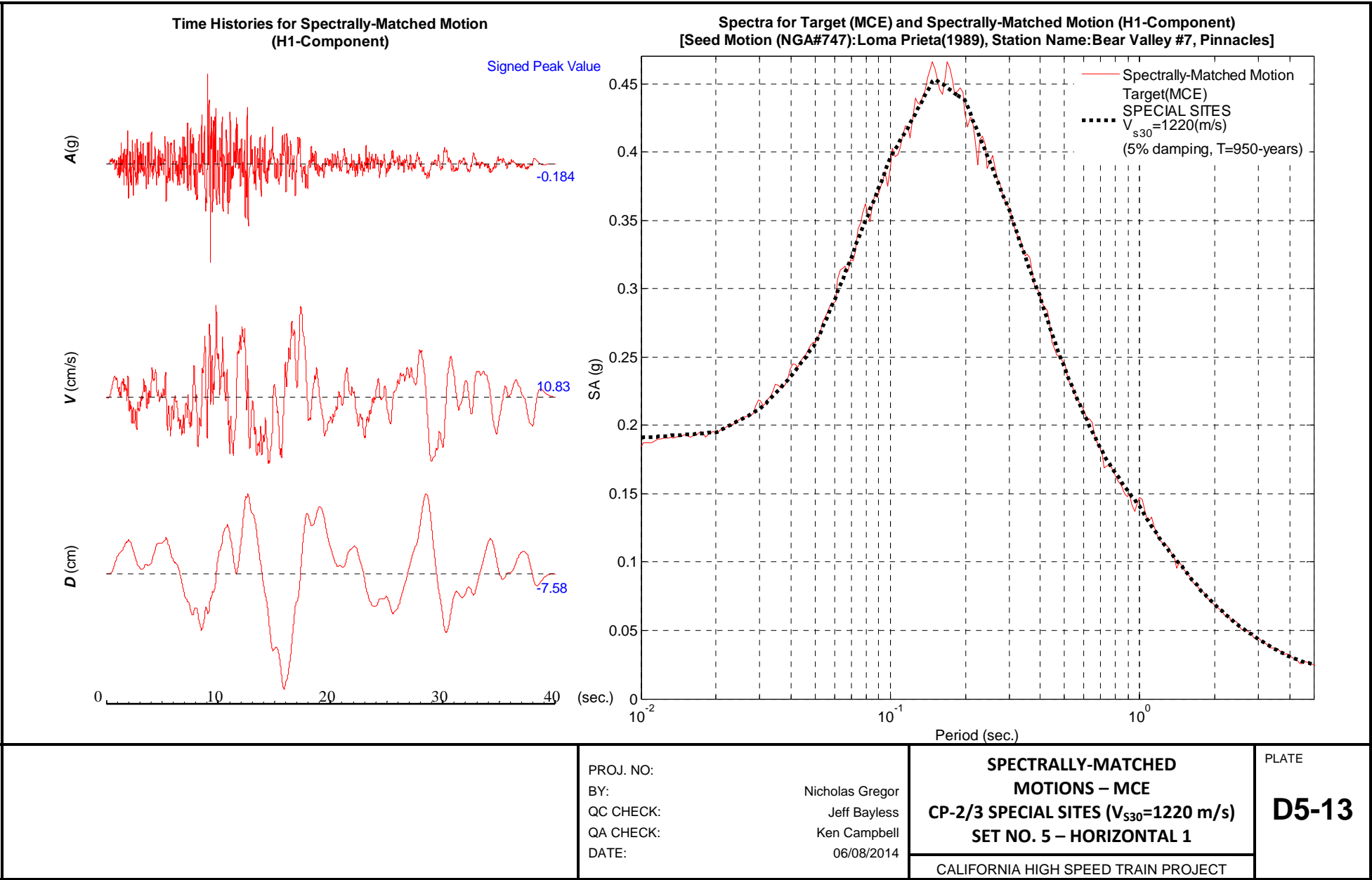




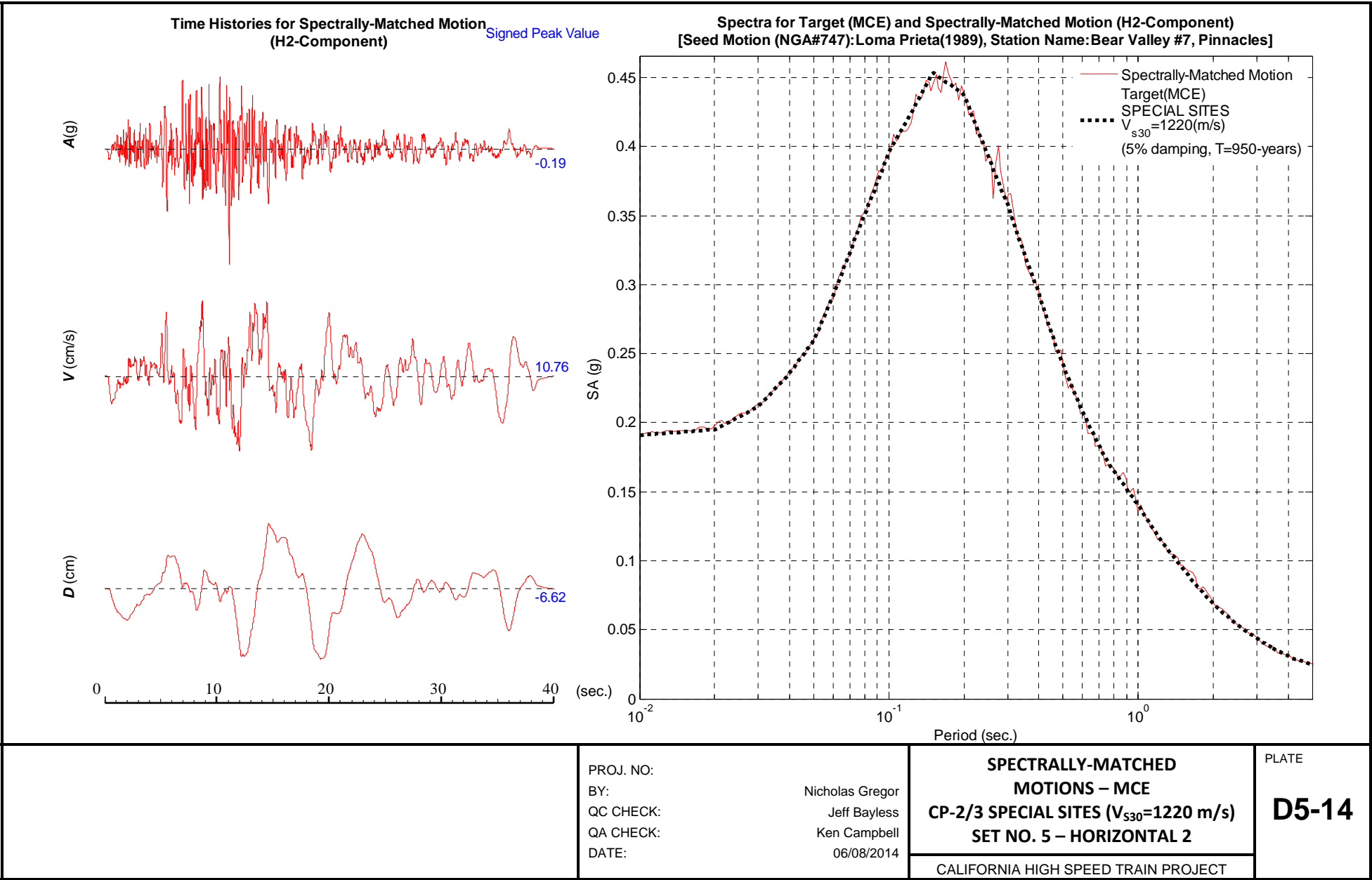
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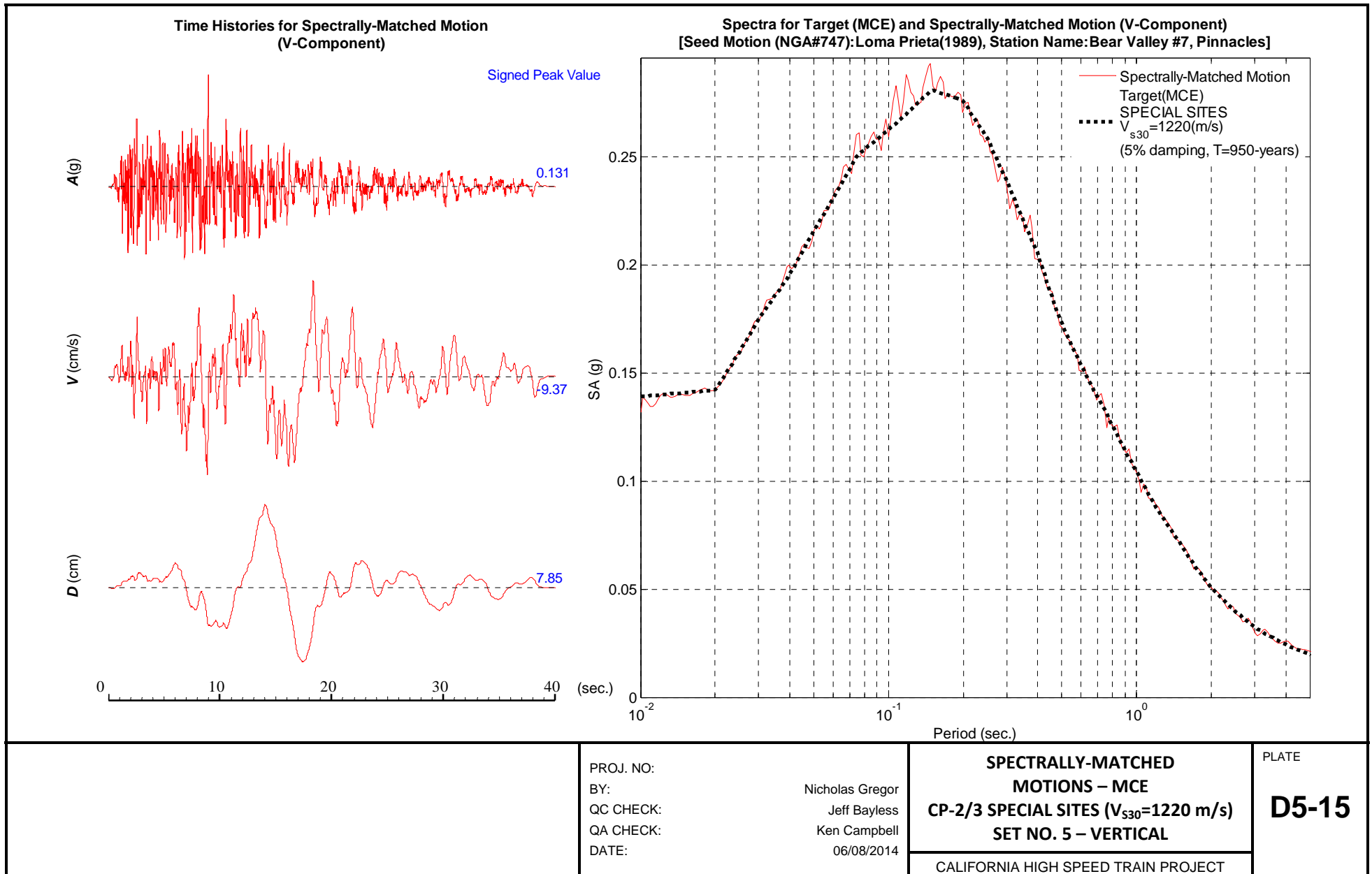


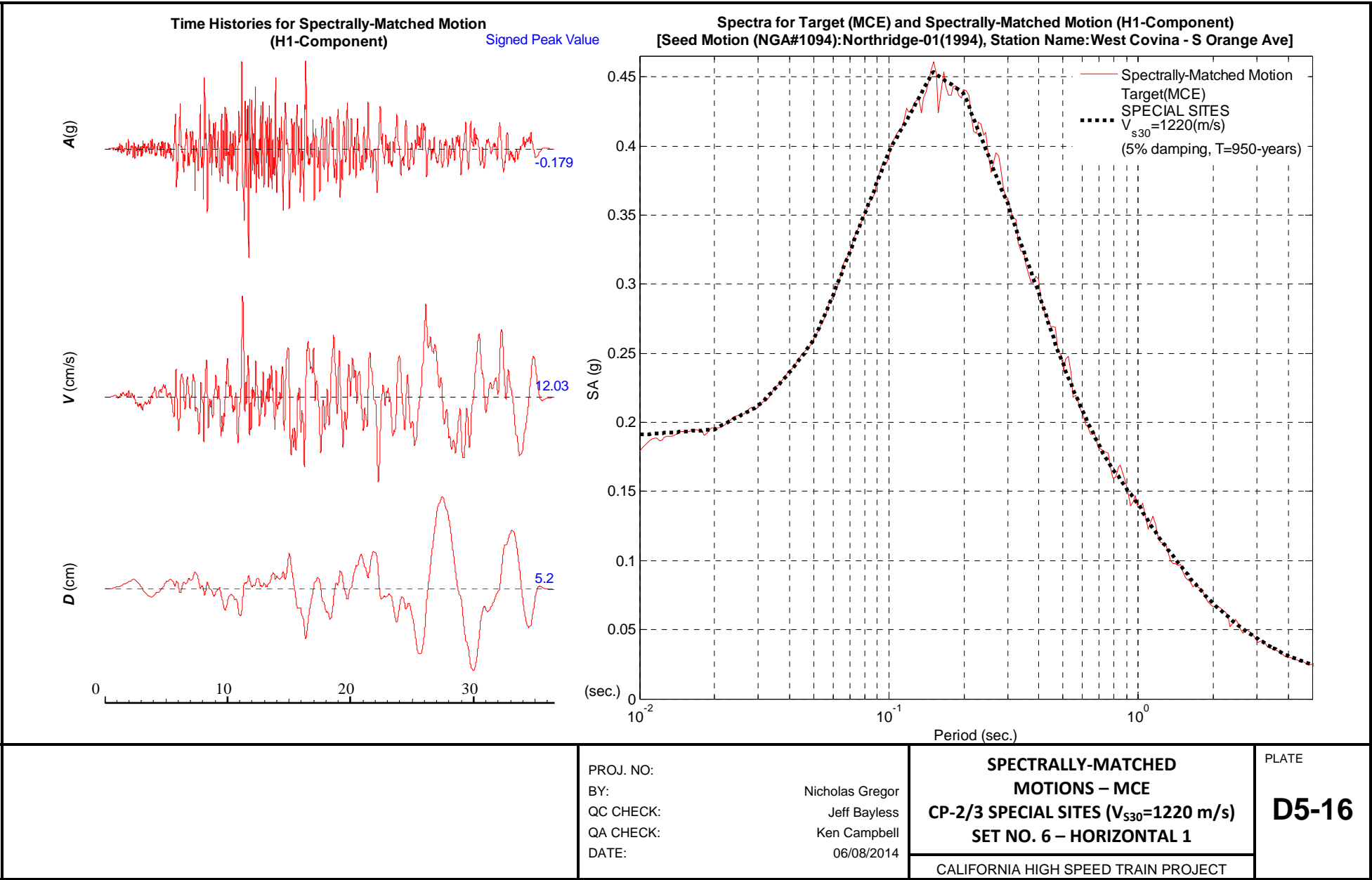
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



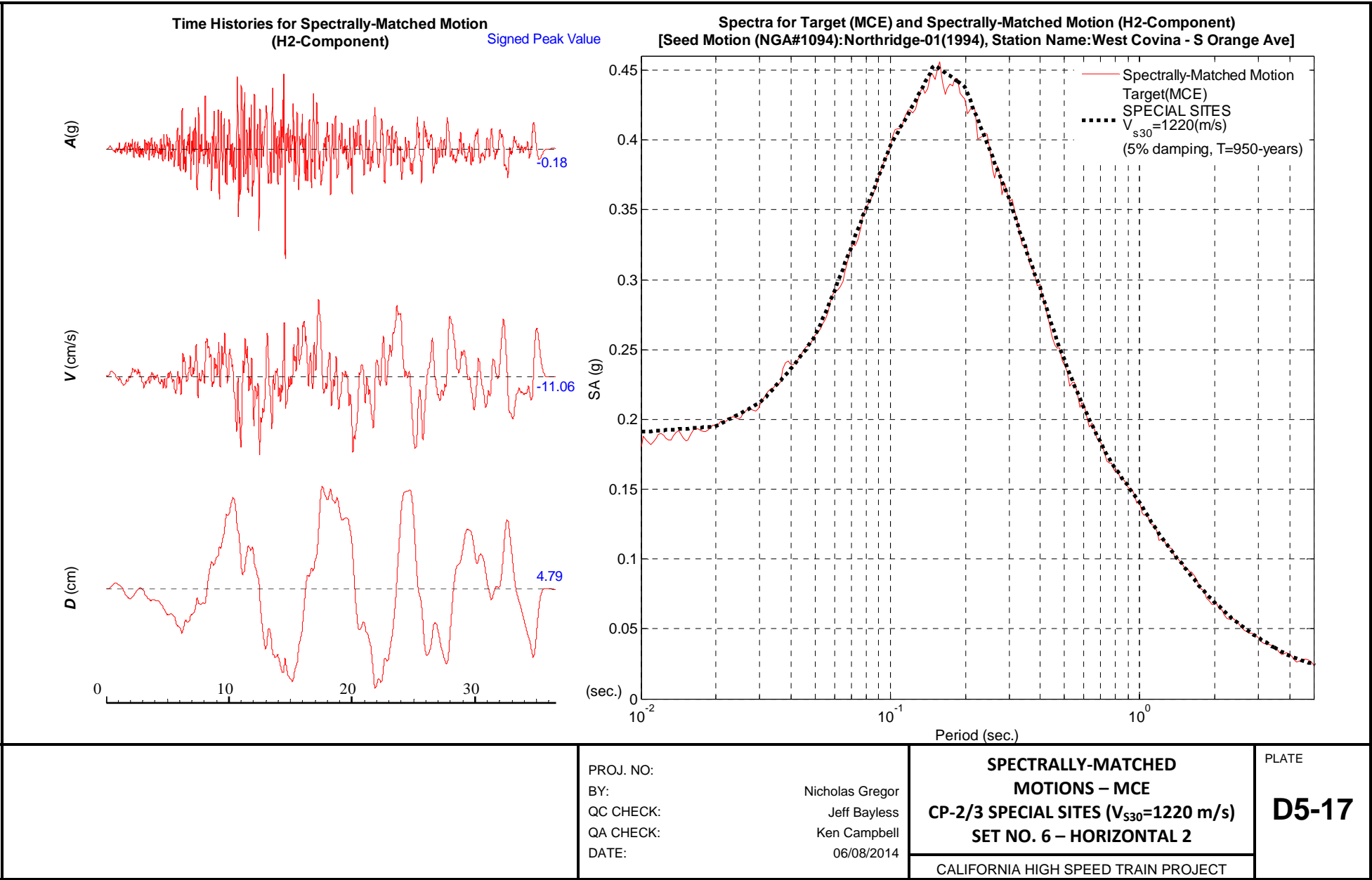
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014





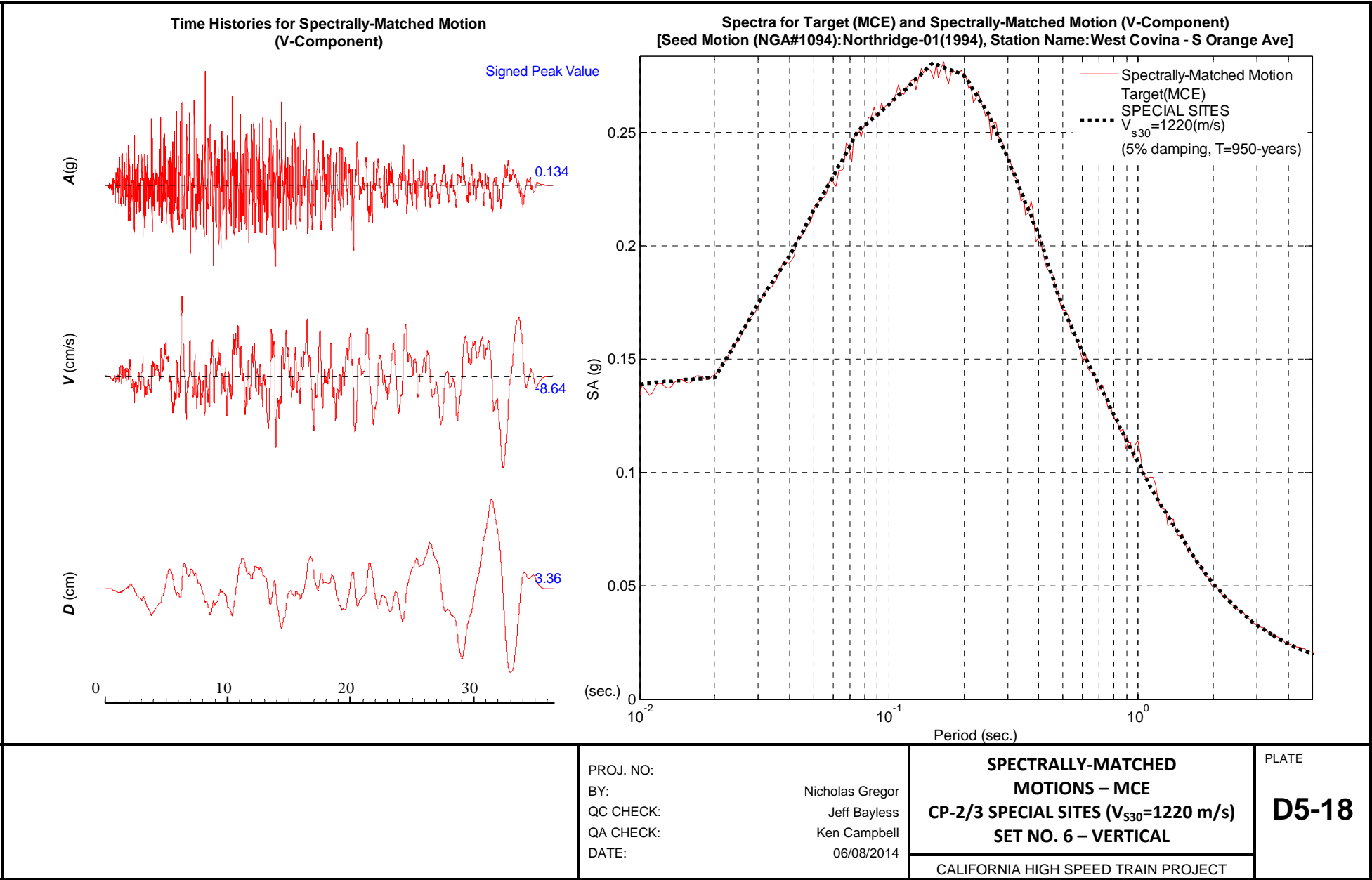


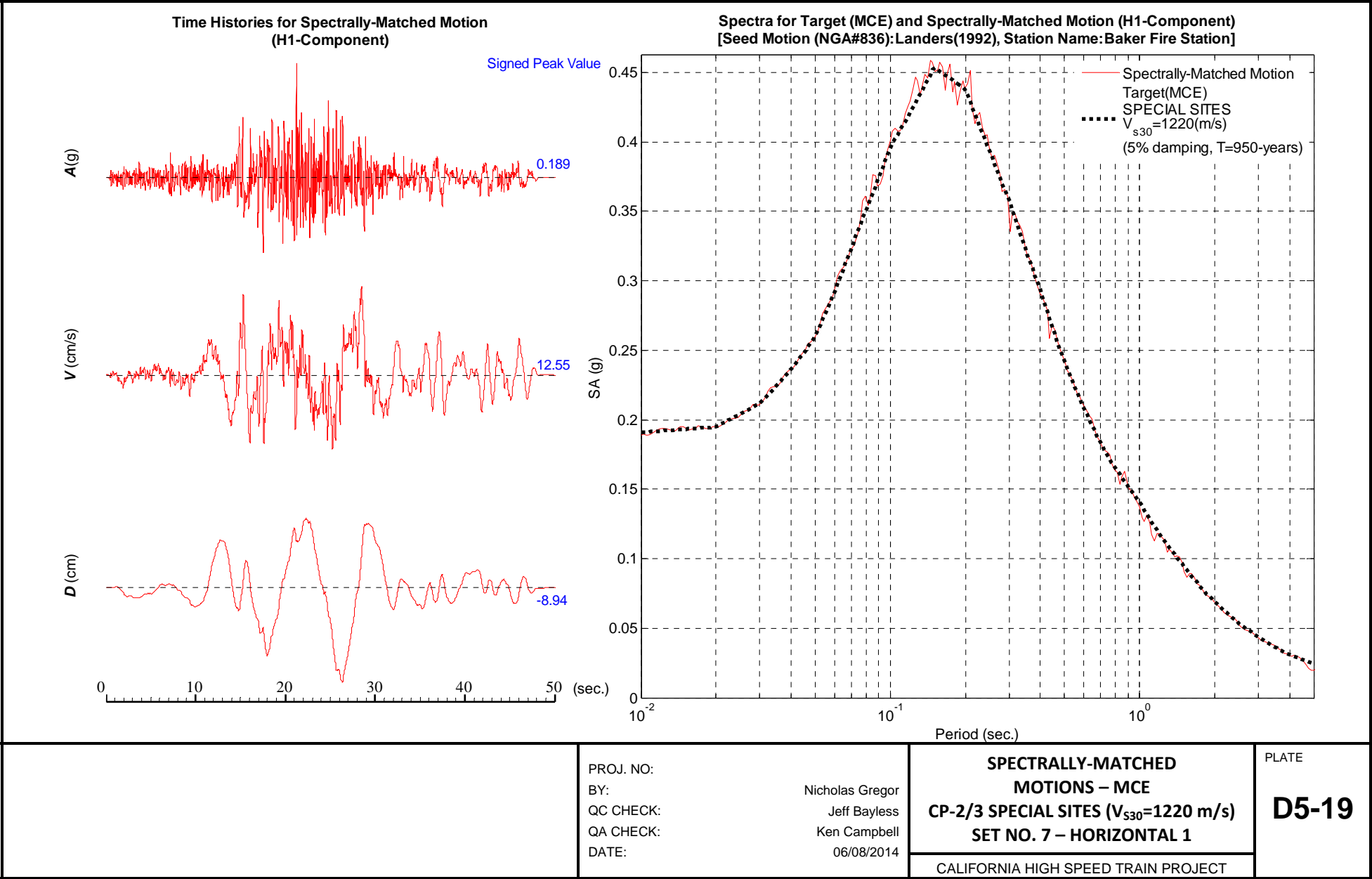
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

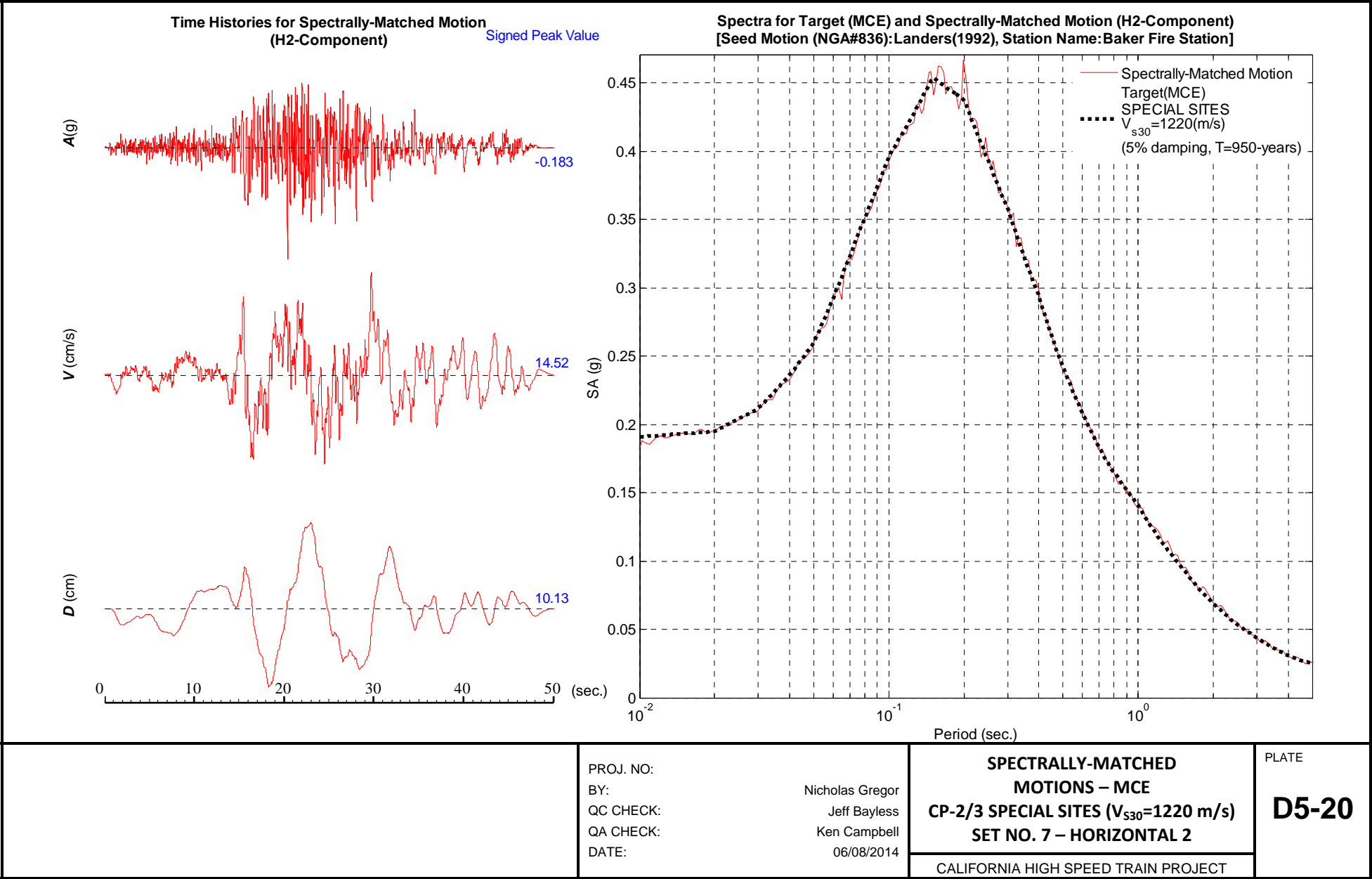


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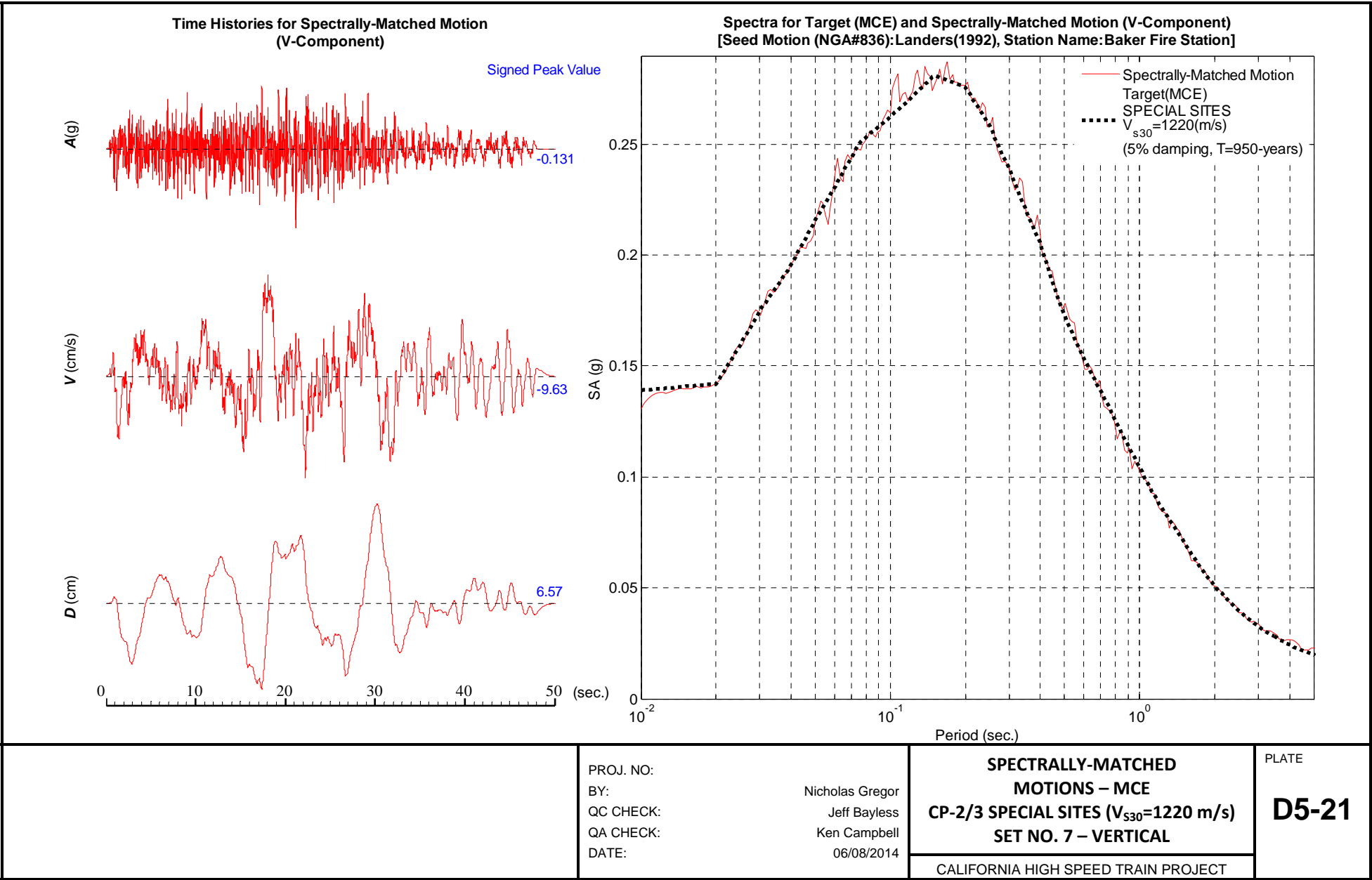








RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

**Table D.2:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for CP-2/3 Special Sites ( $V_{S30}=520$  m/s)**

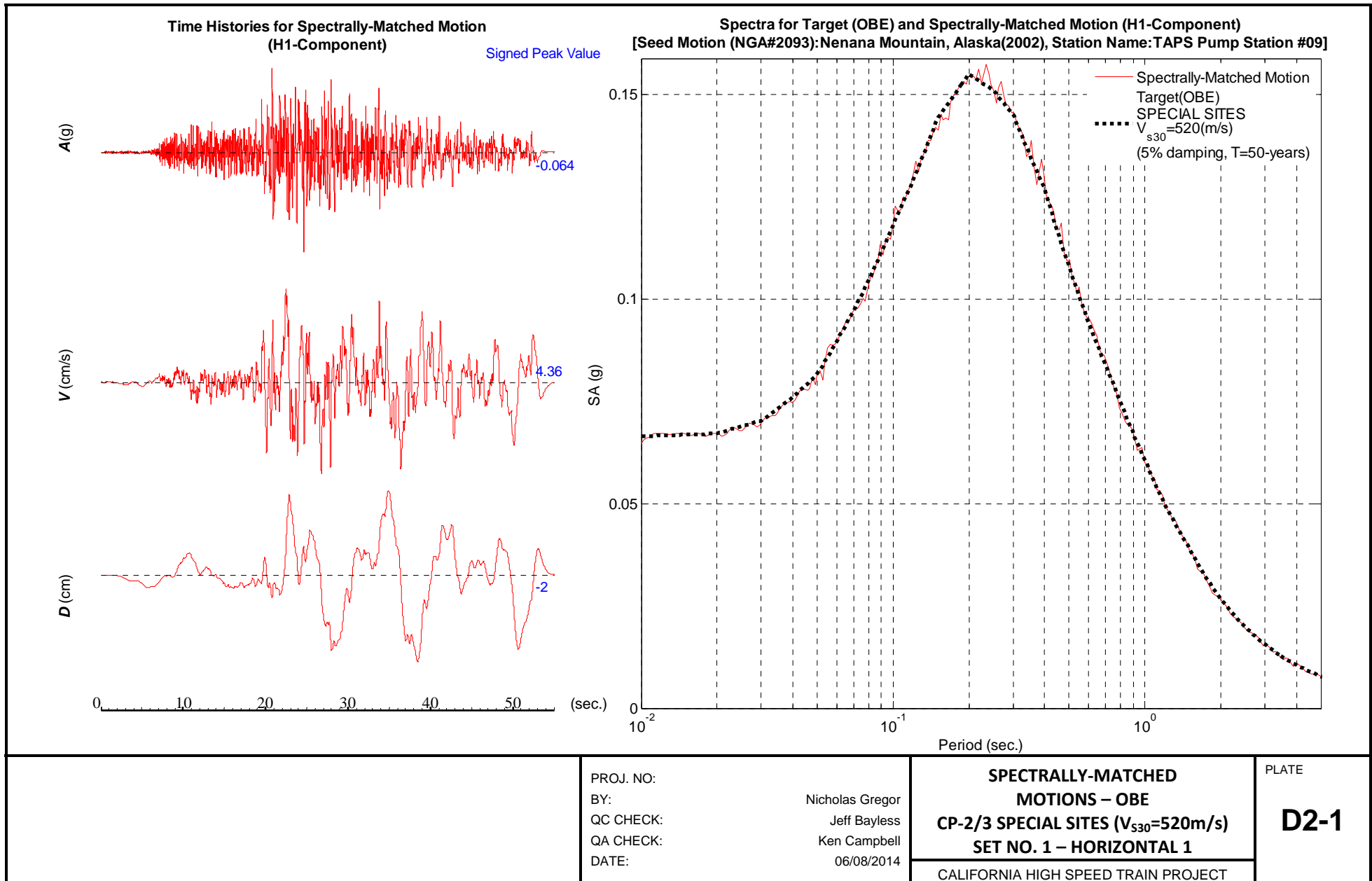
Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2093	Nenana Mountain, Alaska	2002	TAPS Pump Station #09	6.70	104.73	0.065	4.365	2.007	0.066	4.071	2.024	0.041	2.348	1.140
2	1842	Hector Mine	1999	Wrightwood Post Office	7.13	118.71	0.066	5.044	4.229	0.063	4.057	2.015	0.040	2.591	1.730
3	929	Big Bear-01	1992	Salton City	6.46	129.76	0.065	5.421	1.786	0.066	4.673	1.311	0.039	2.750	0.916
4	3129	Chi-Chi, Taiwan-05	1999	TAP051	6.20	139.34	0.066	4.758	1.659	0.067	3.907	1.587	0.041	2.398	0.965
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.062	4.637	1.968	0.068	6.278	2.939	0.040	3.338	1.479
6	1766	Hector Mine	1999	Baker Fire Station	7.13	64.79	0.065	5.039	2.020	0.065	3.772	1.942	0.041	2.645	1.304
7	734	Loma Prieta	1989	APEEL 3E Hayward CSUH	6.93	52.53	0.064	3.372	2.187	0.066	4.799	2.023	0.040	2.681	1.492

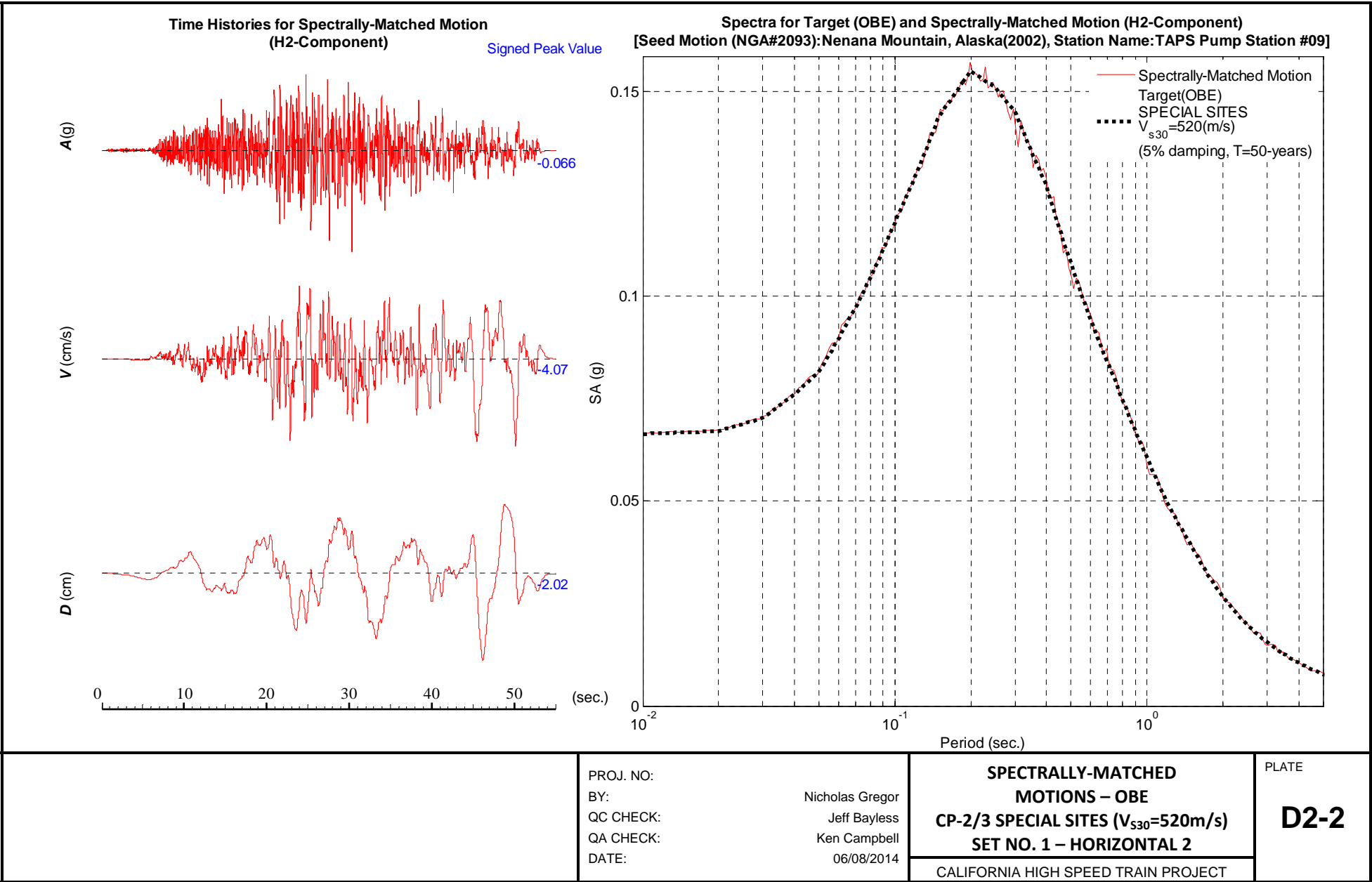
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QA CHECK:  
DATE:

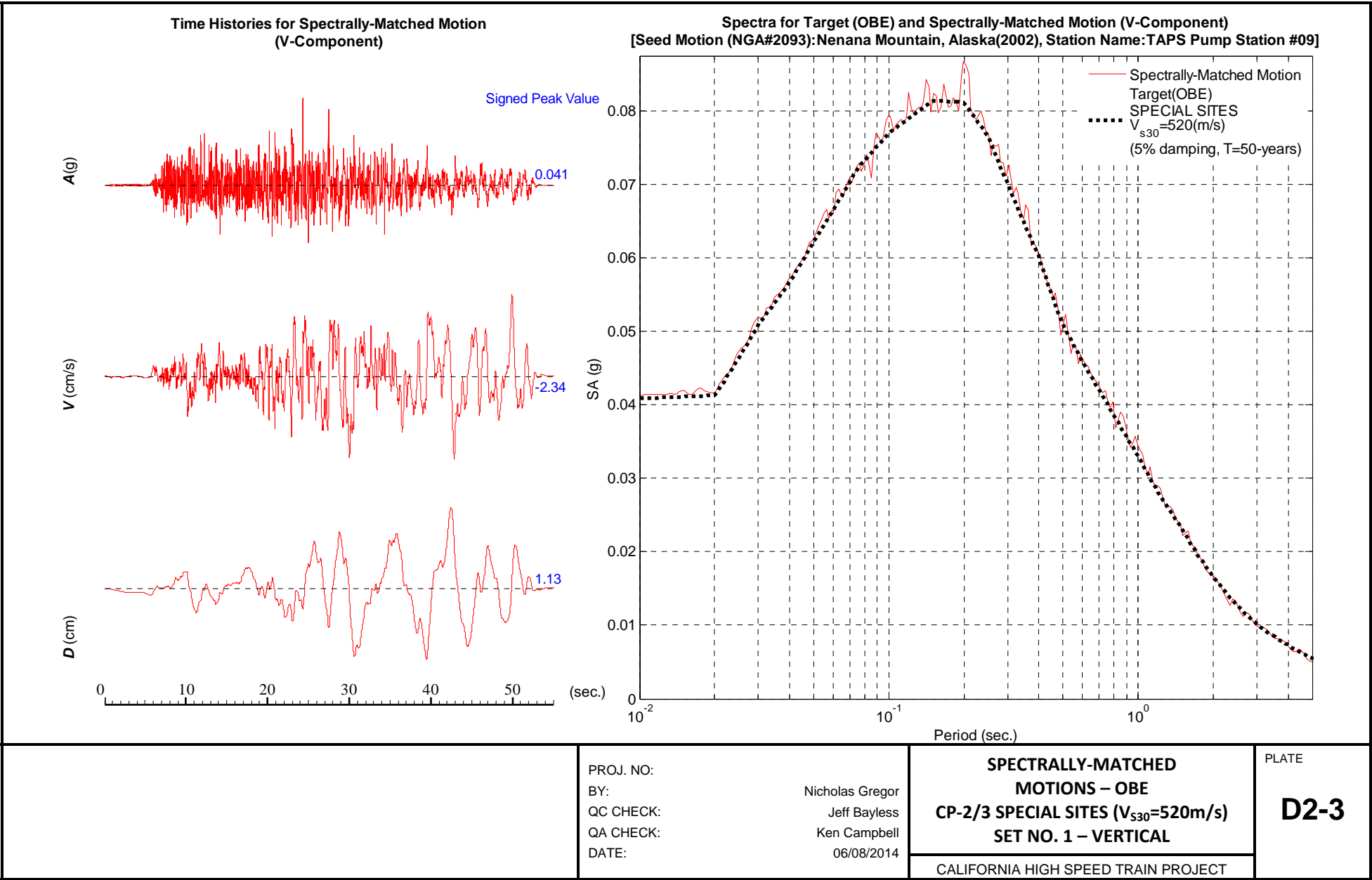
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Jeff Bayless  
Ken Campbell  
06/08/2014

**SELECTED SEED AND  
SPECTRALLY-MATCHED MOTIONS  
OBE – CP-2/3 SPECIAL SITES ( $V_{S30}=520$ m/s)**  
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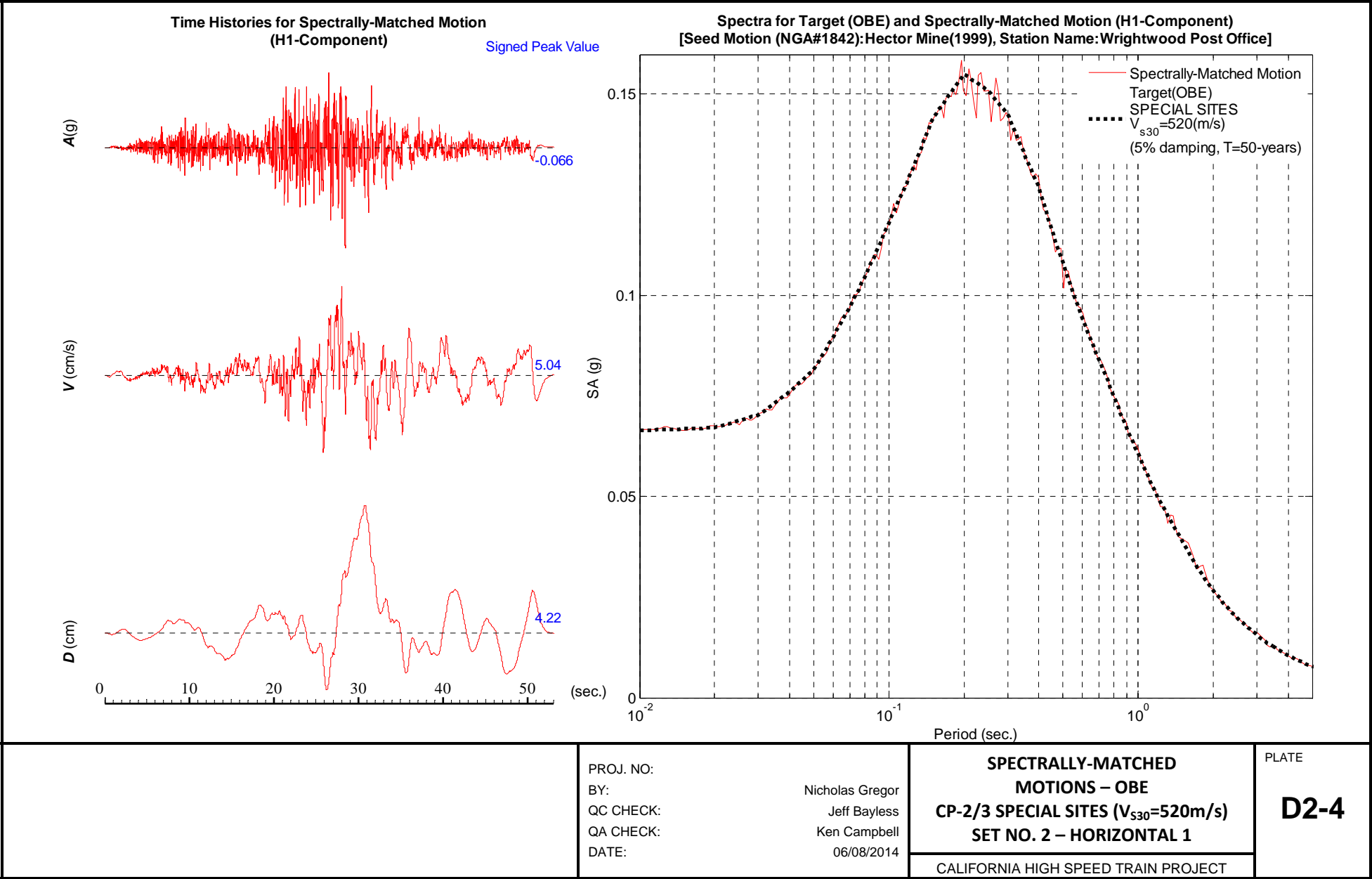
PLATE  
**D2-0**



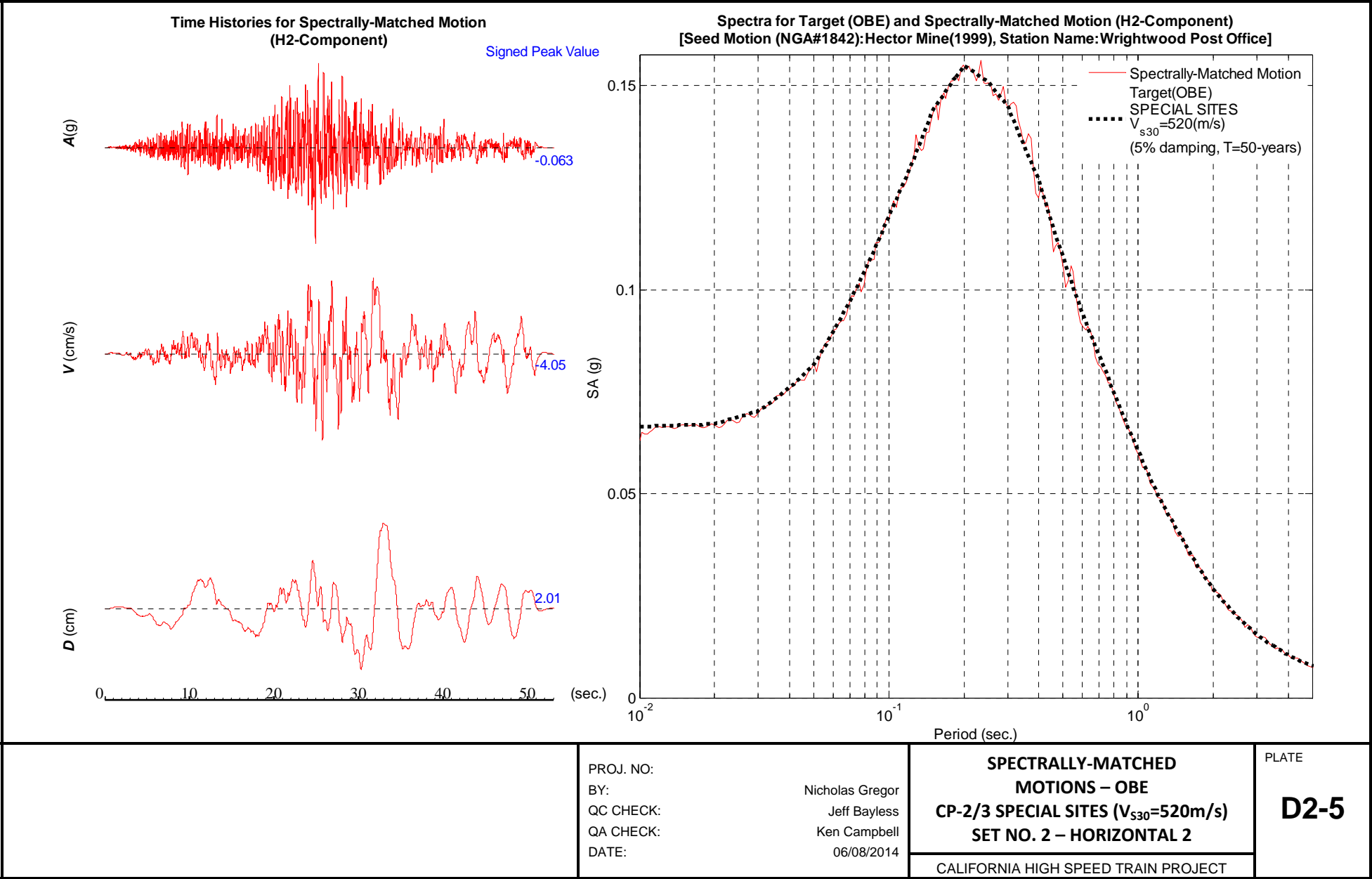




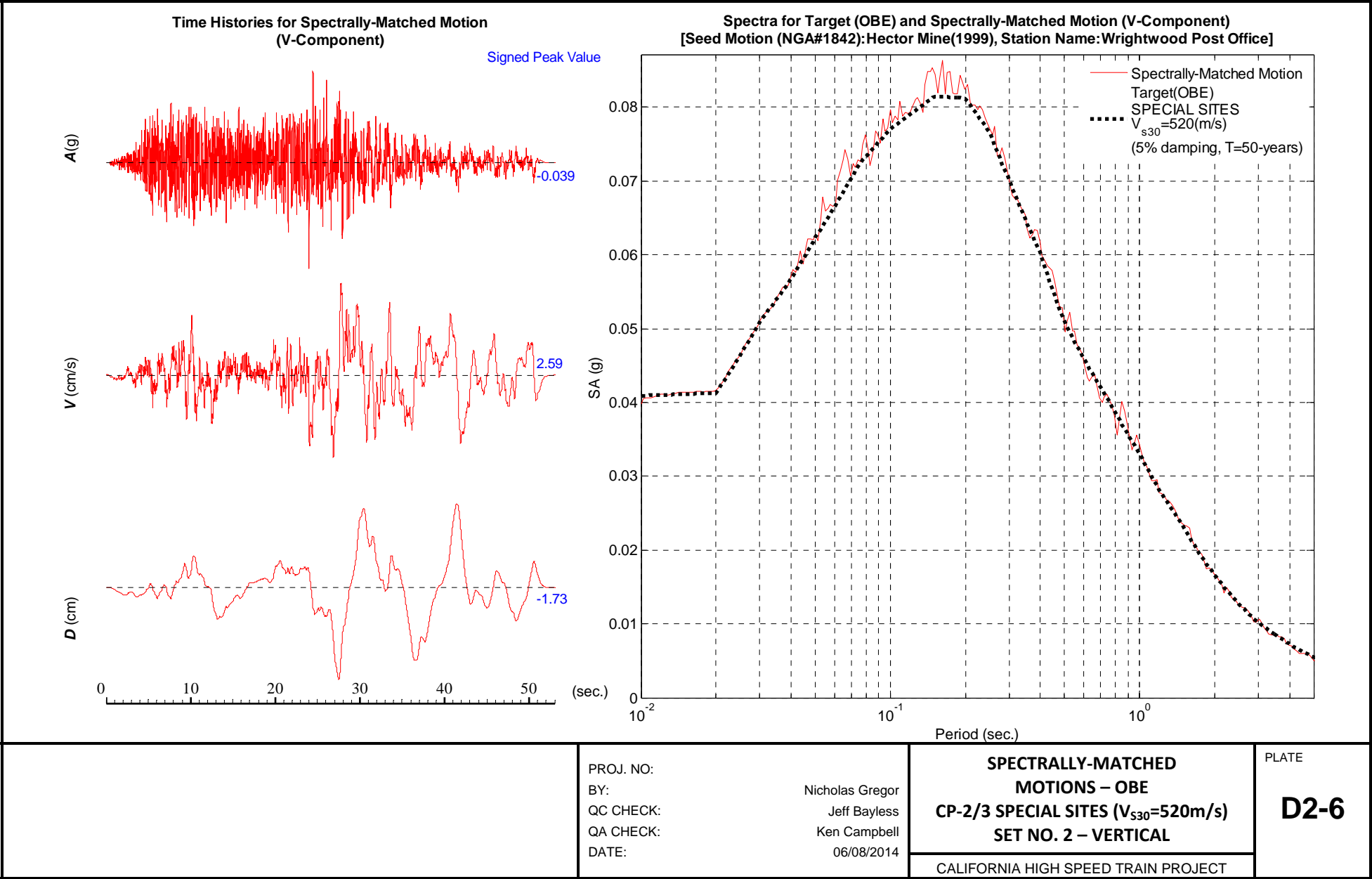


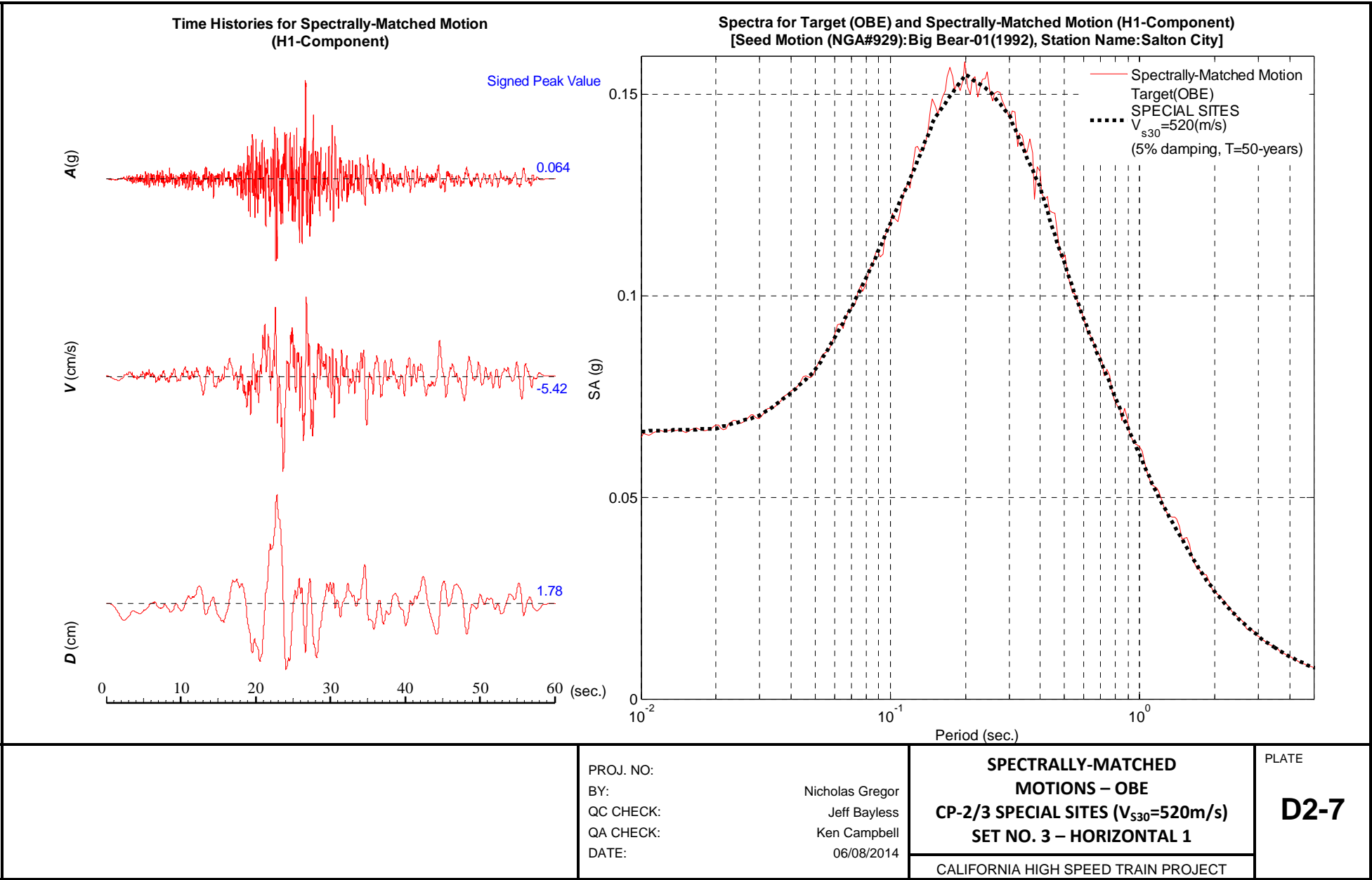


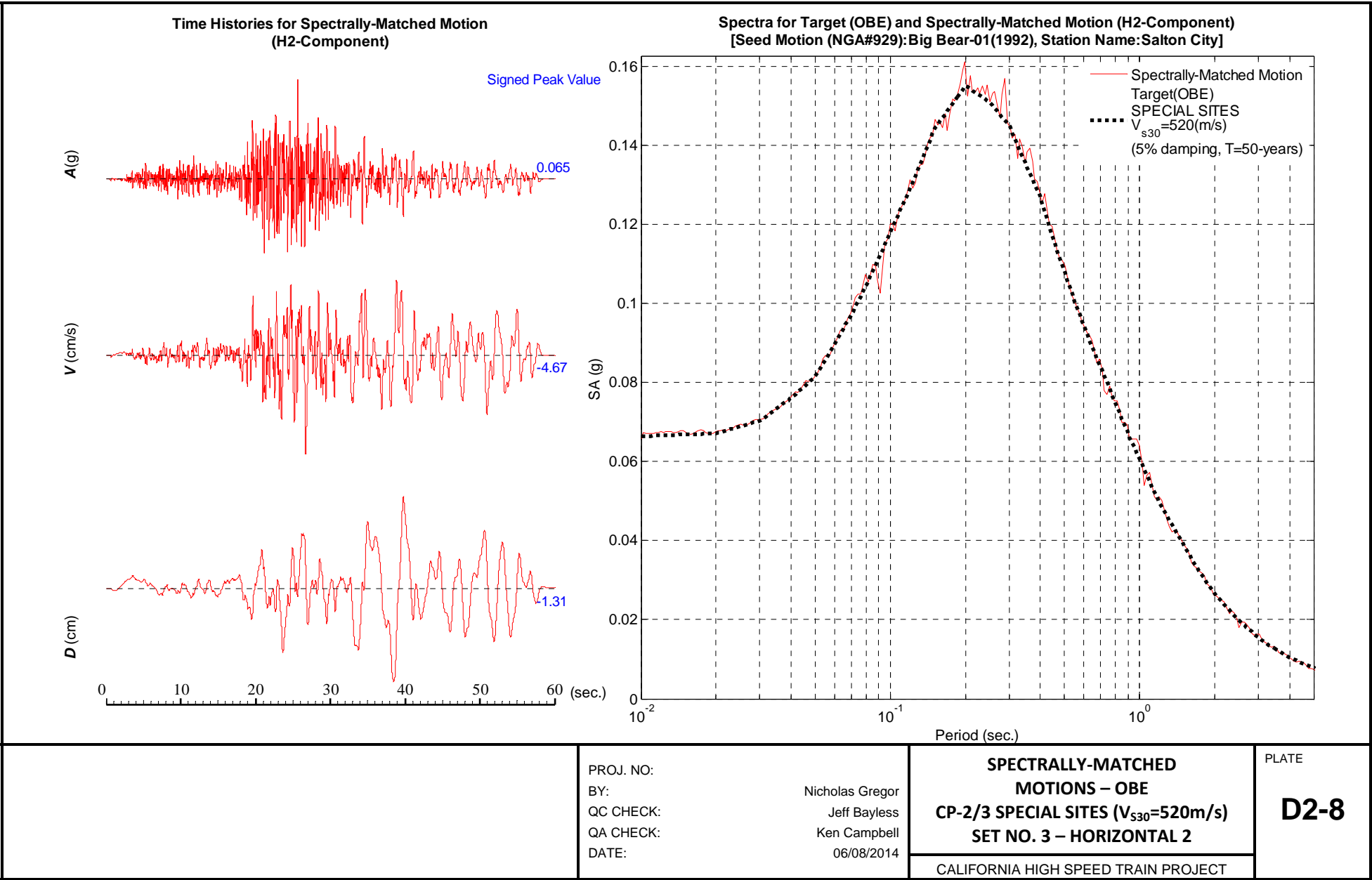
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014



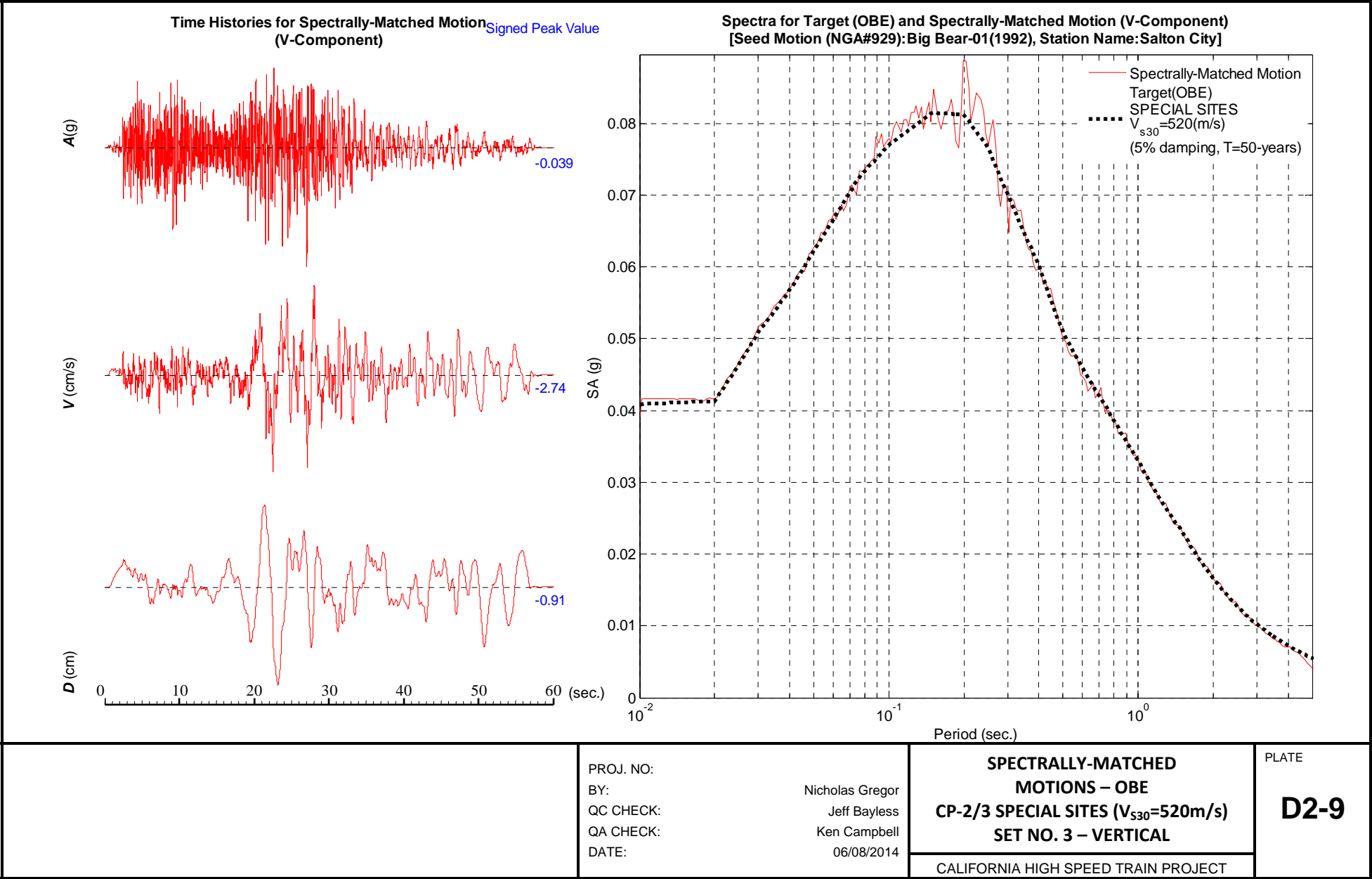
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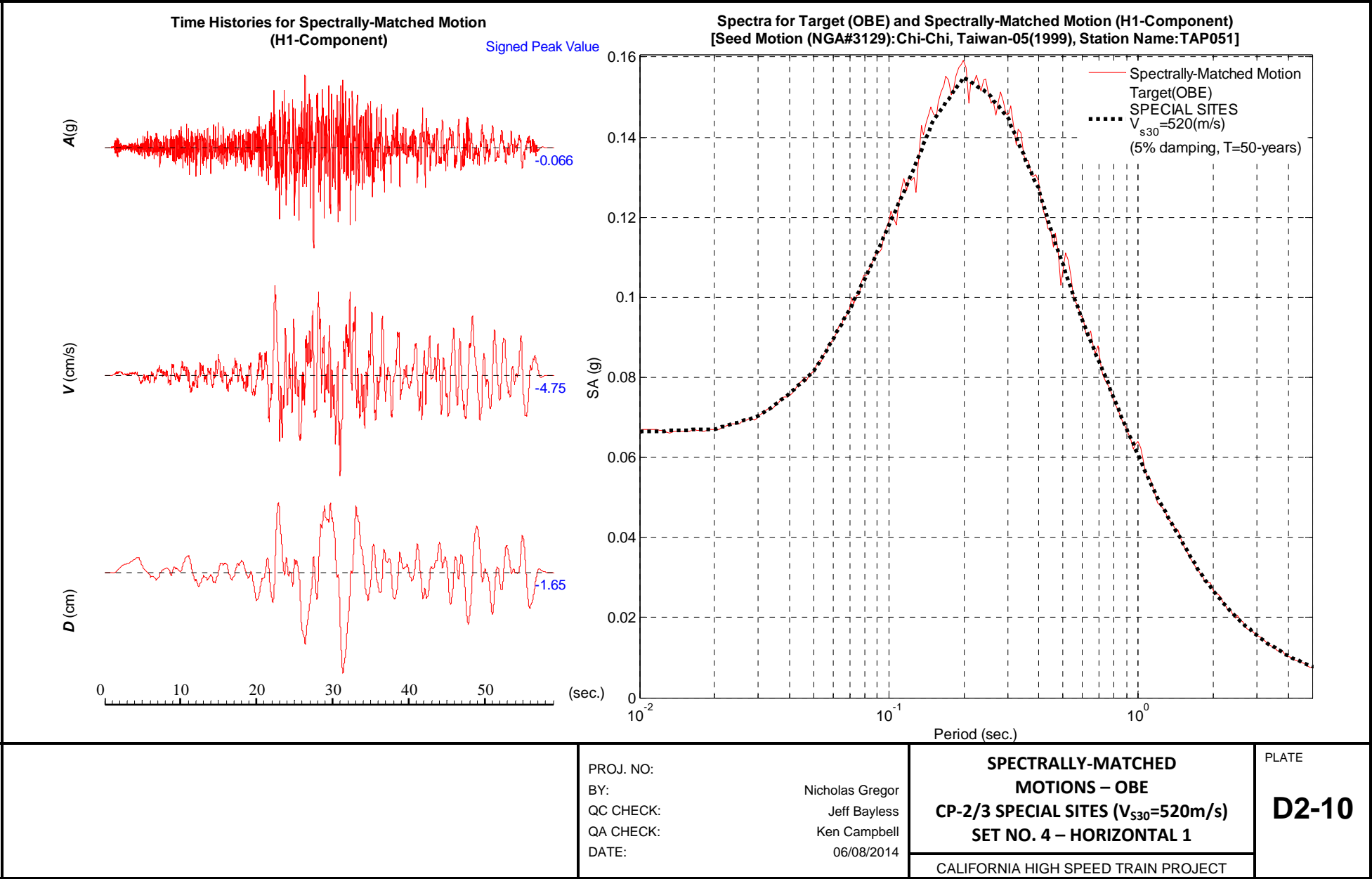


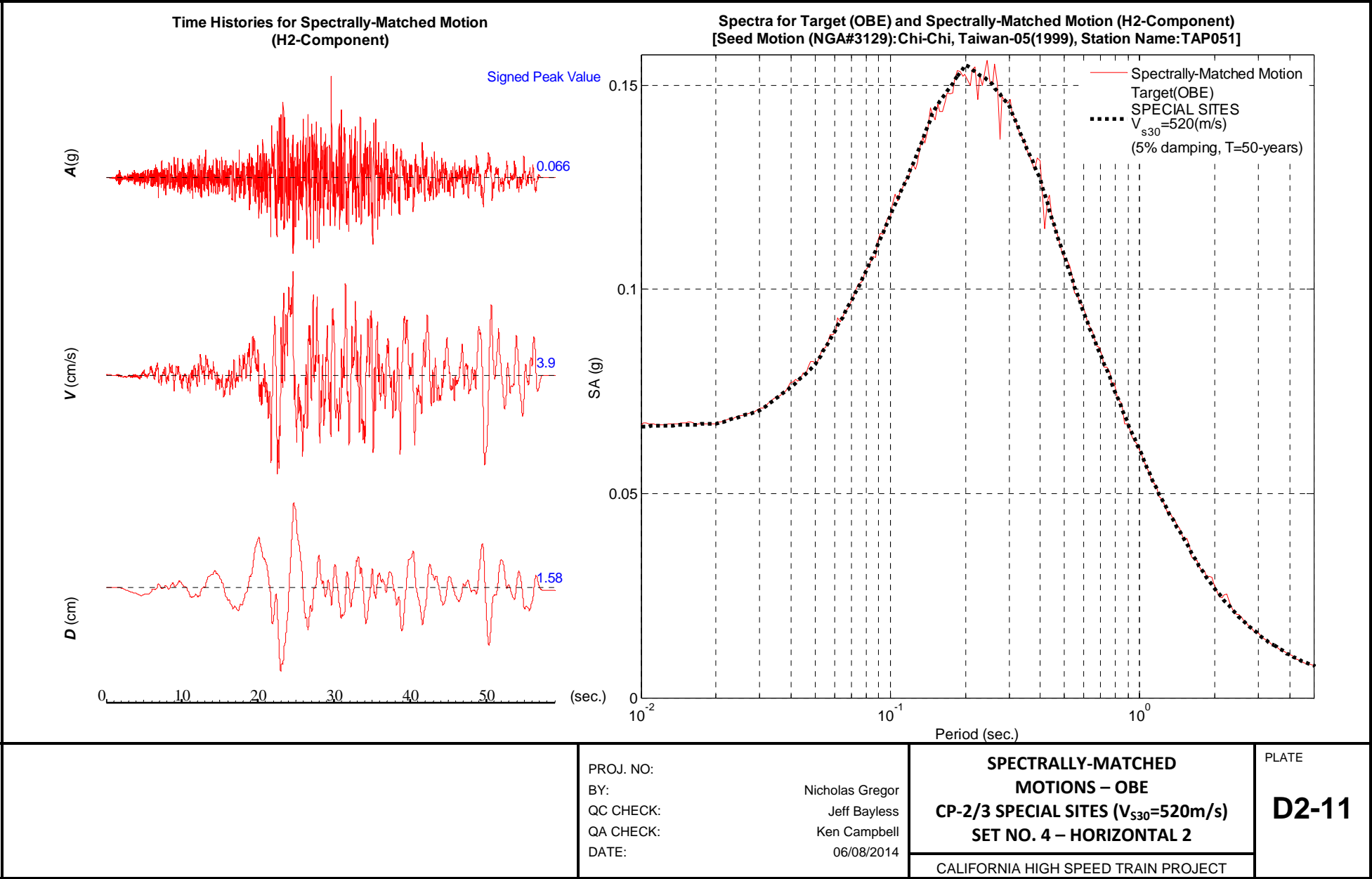




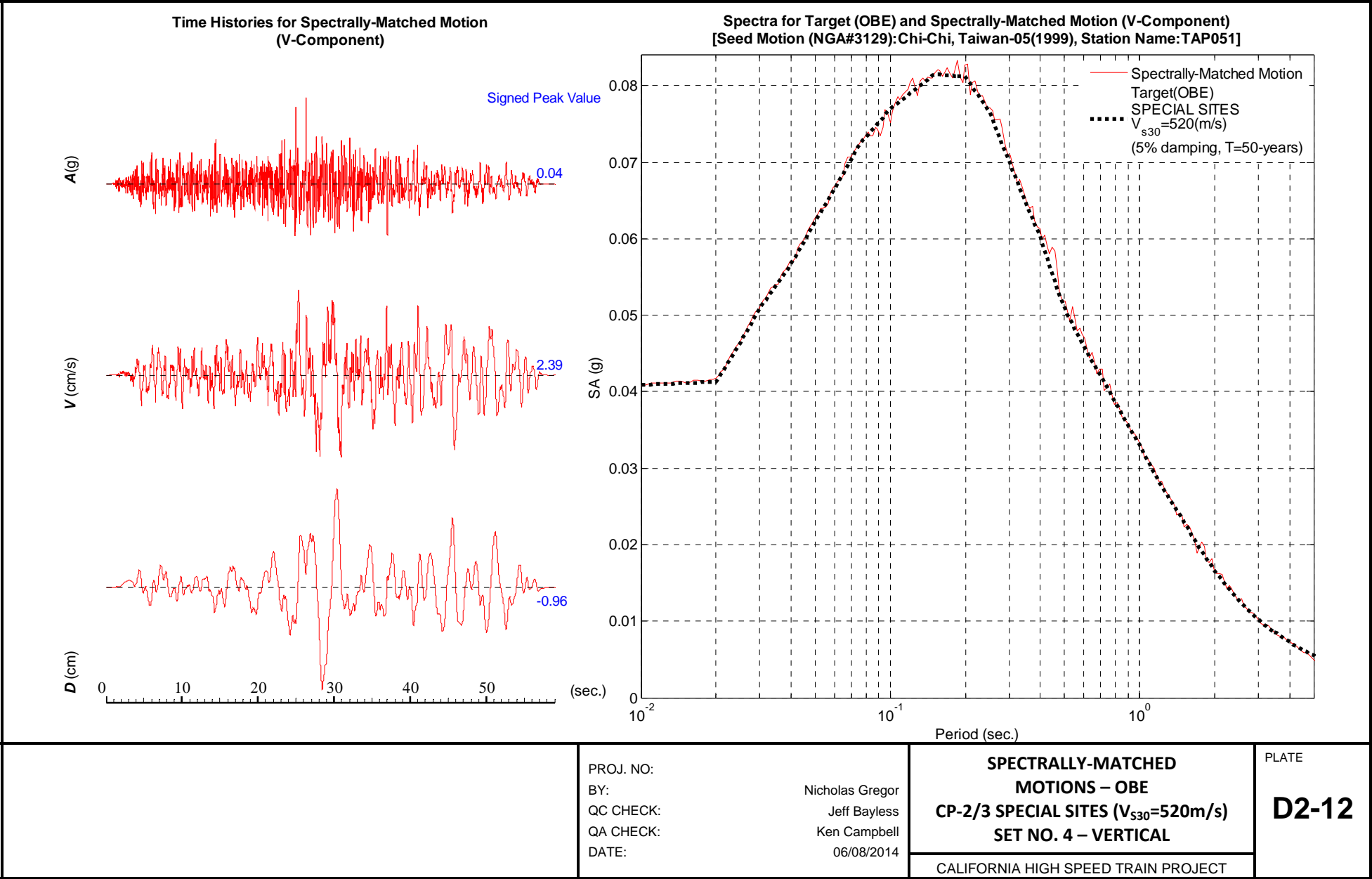
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

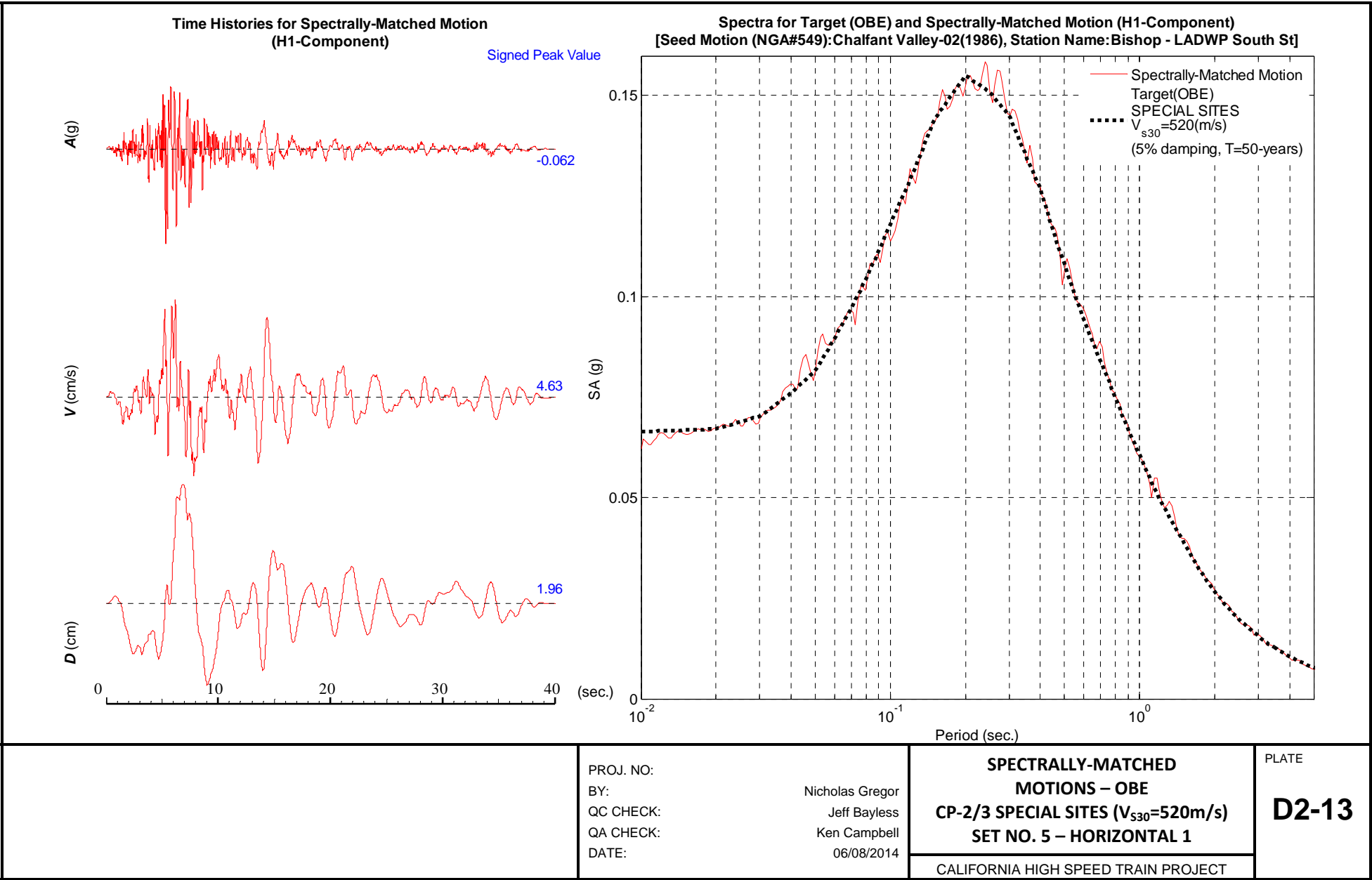




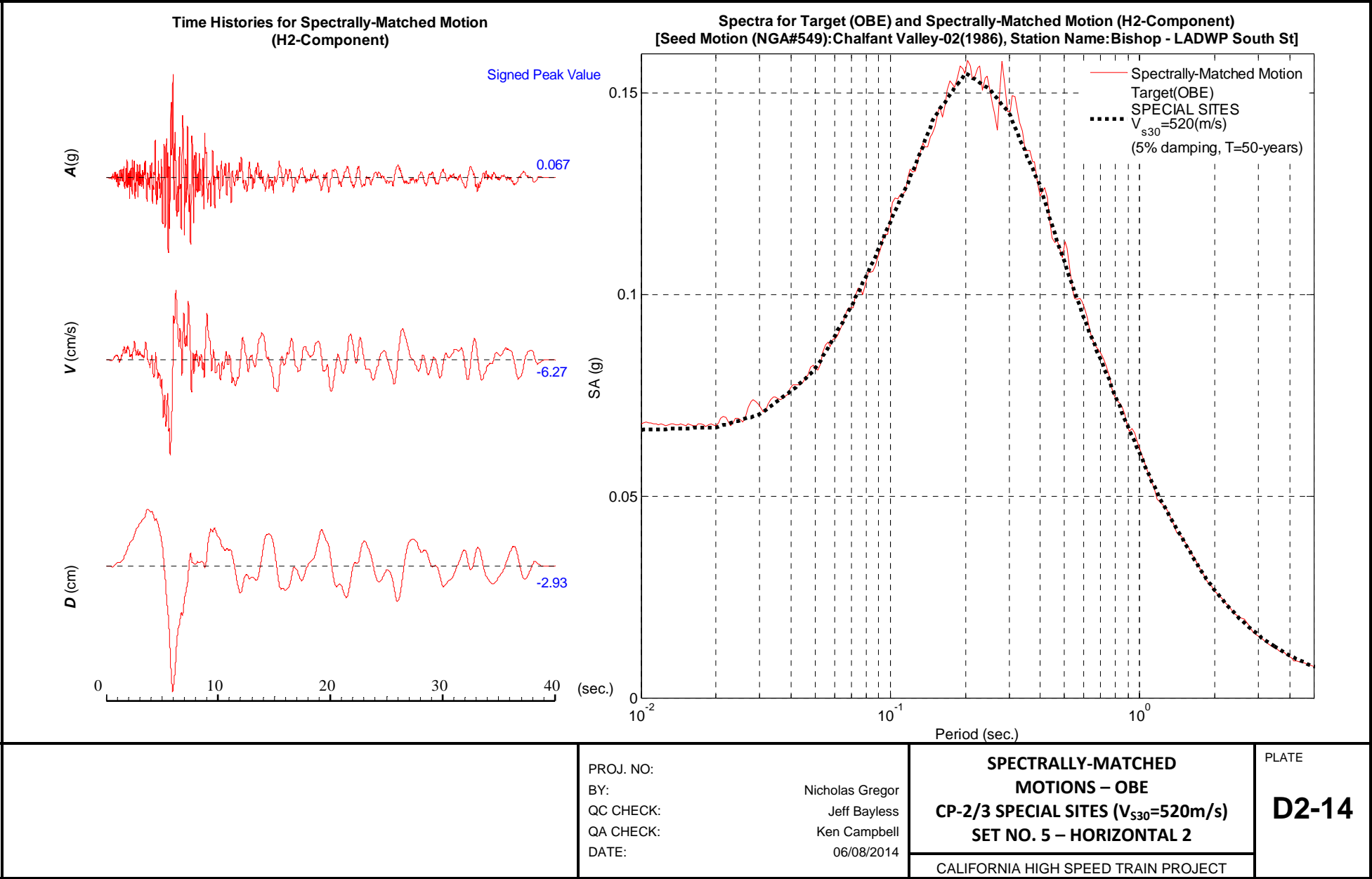


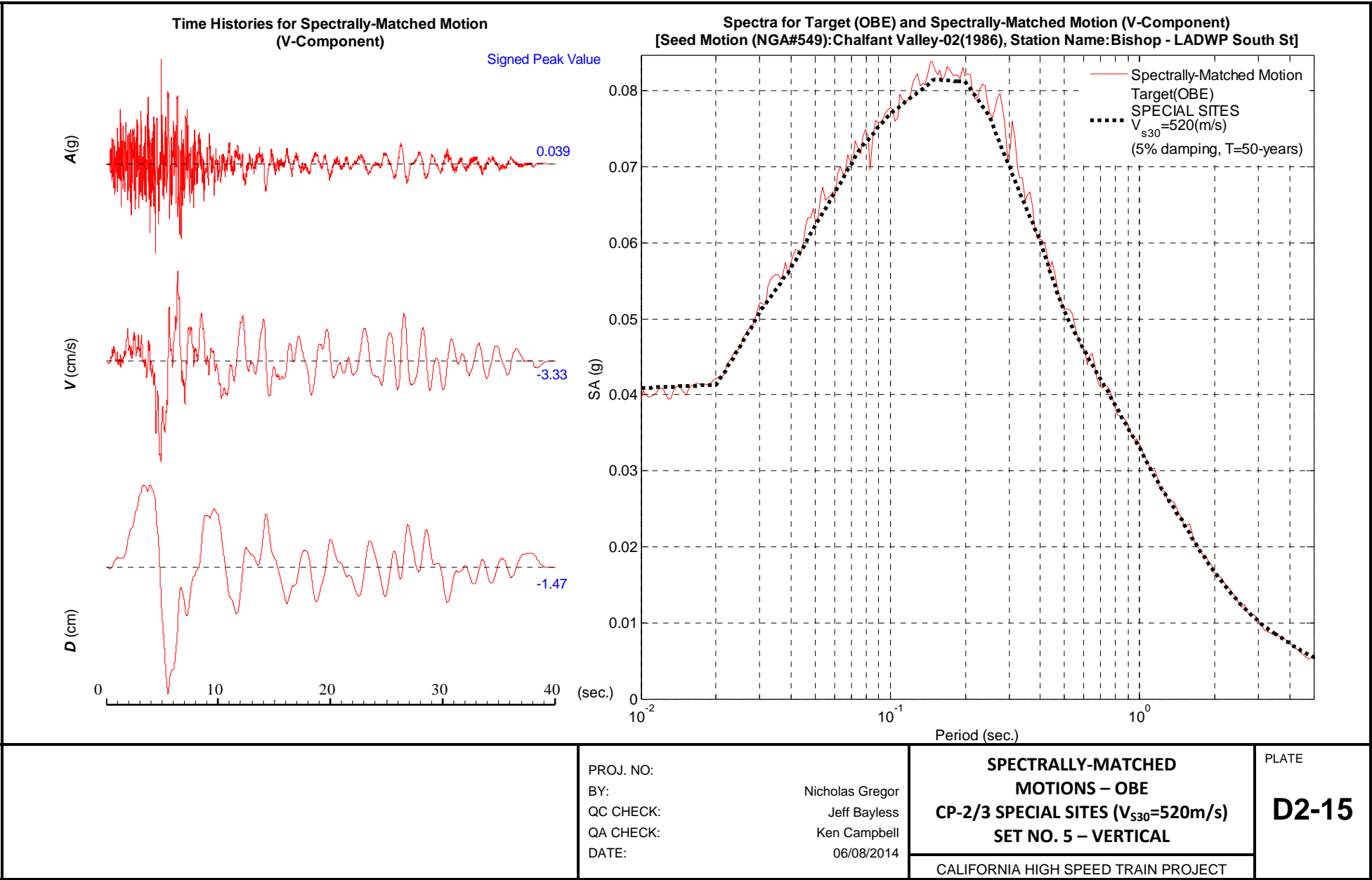


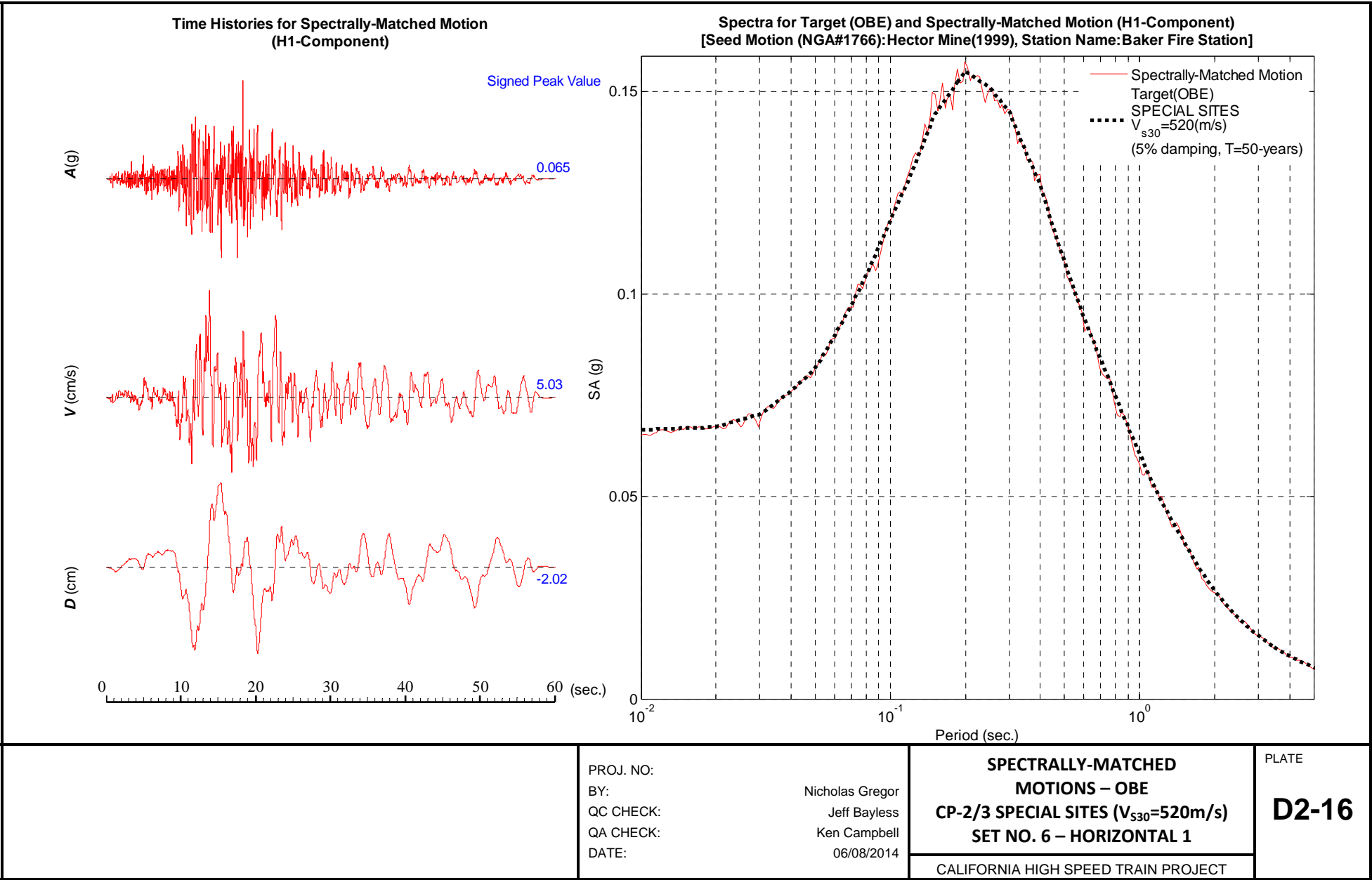


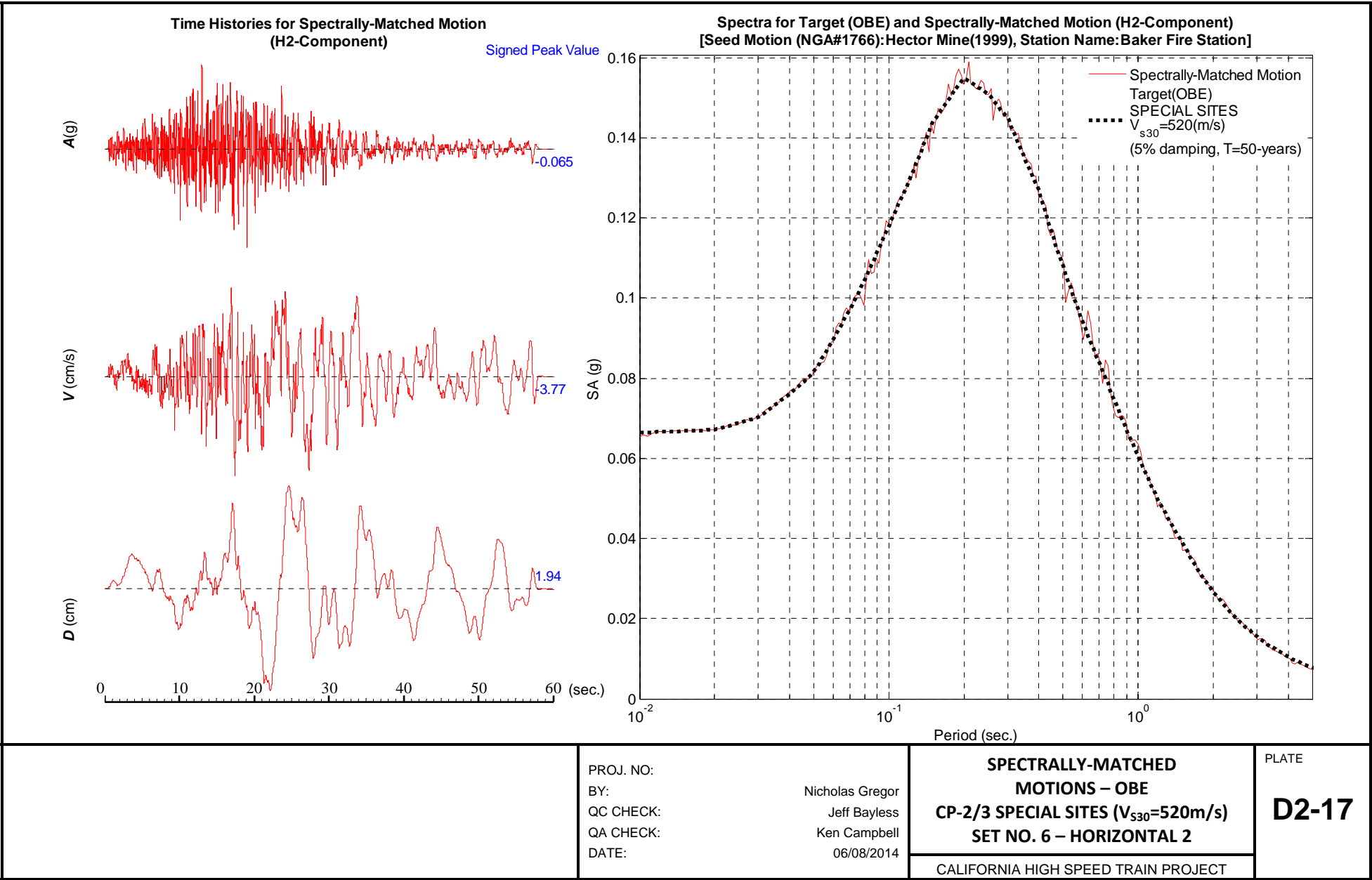


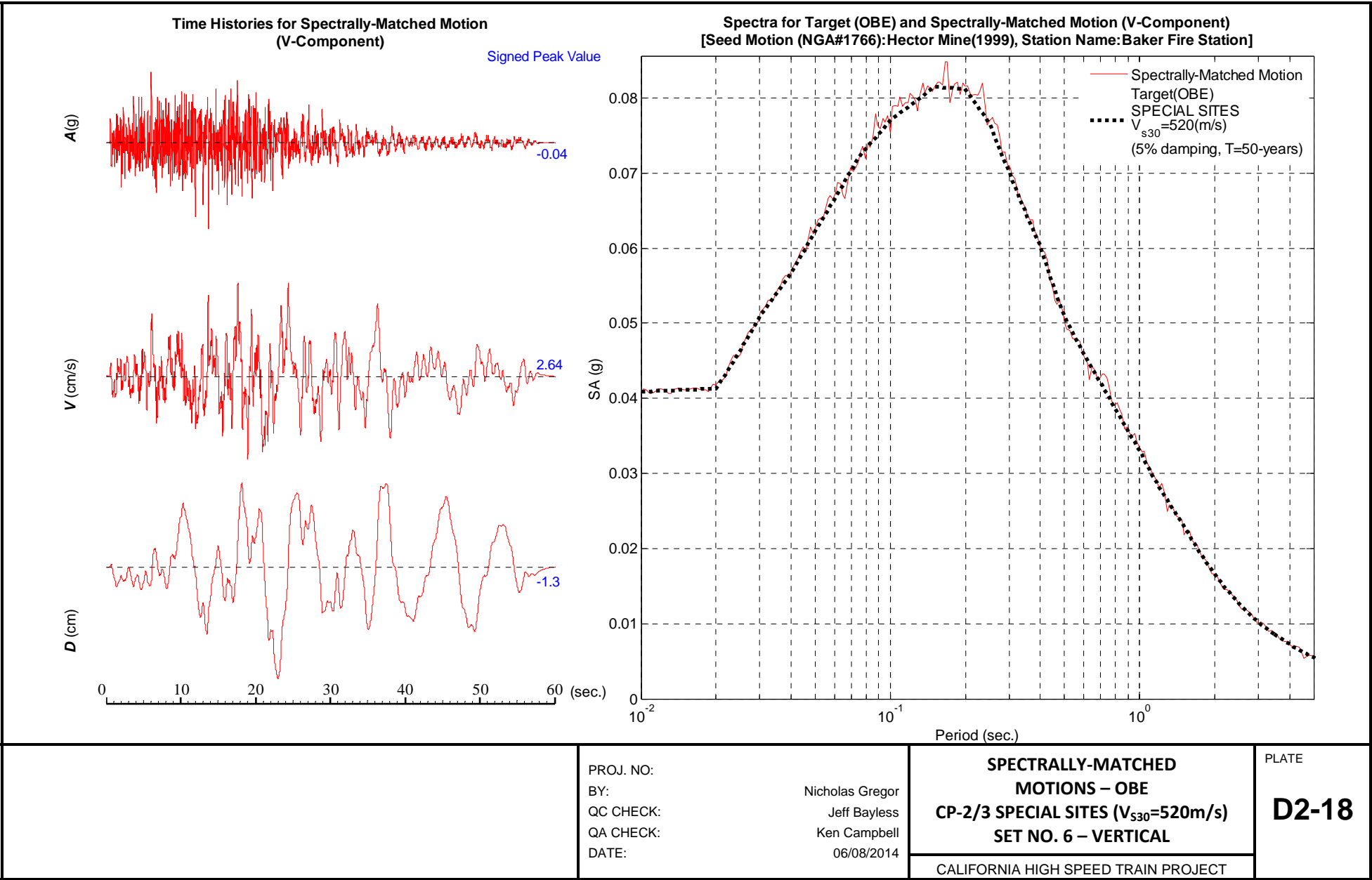
RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

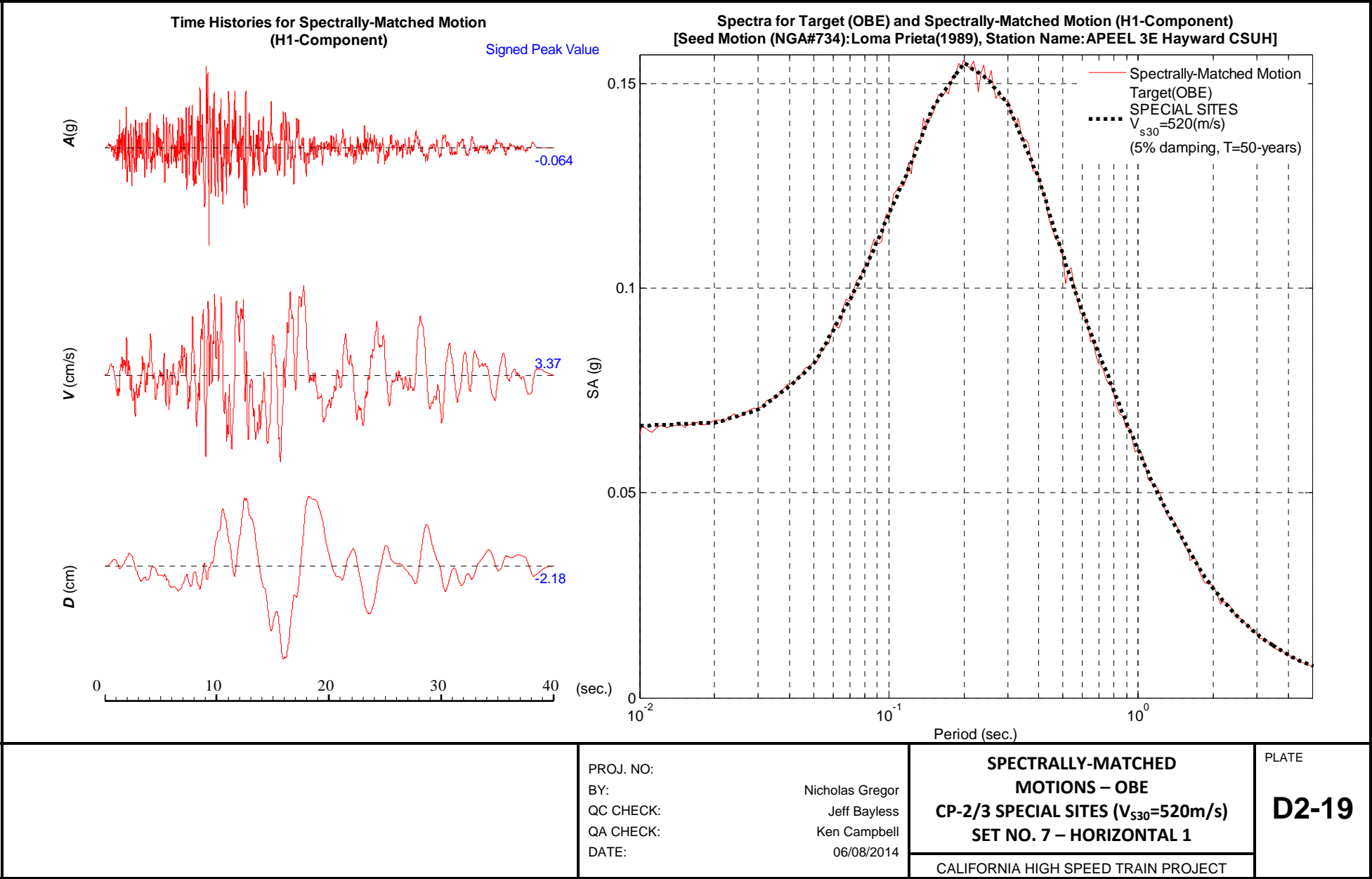






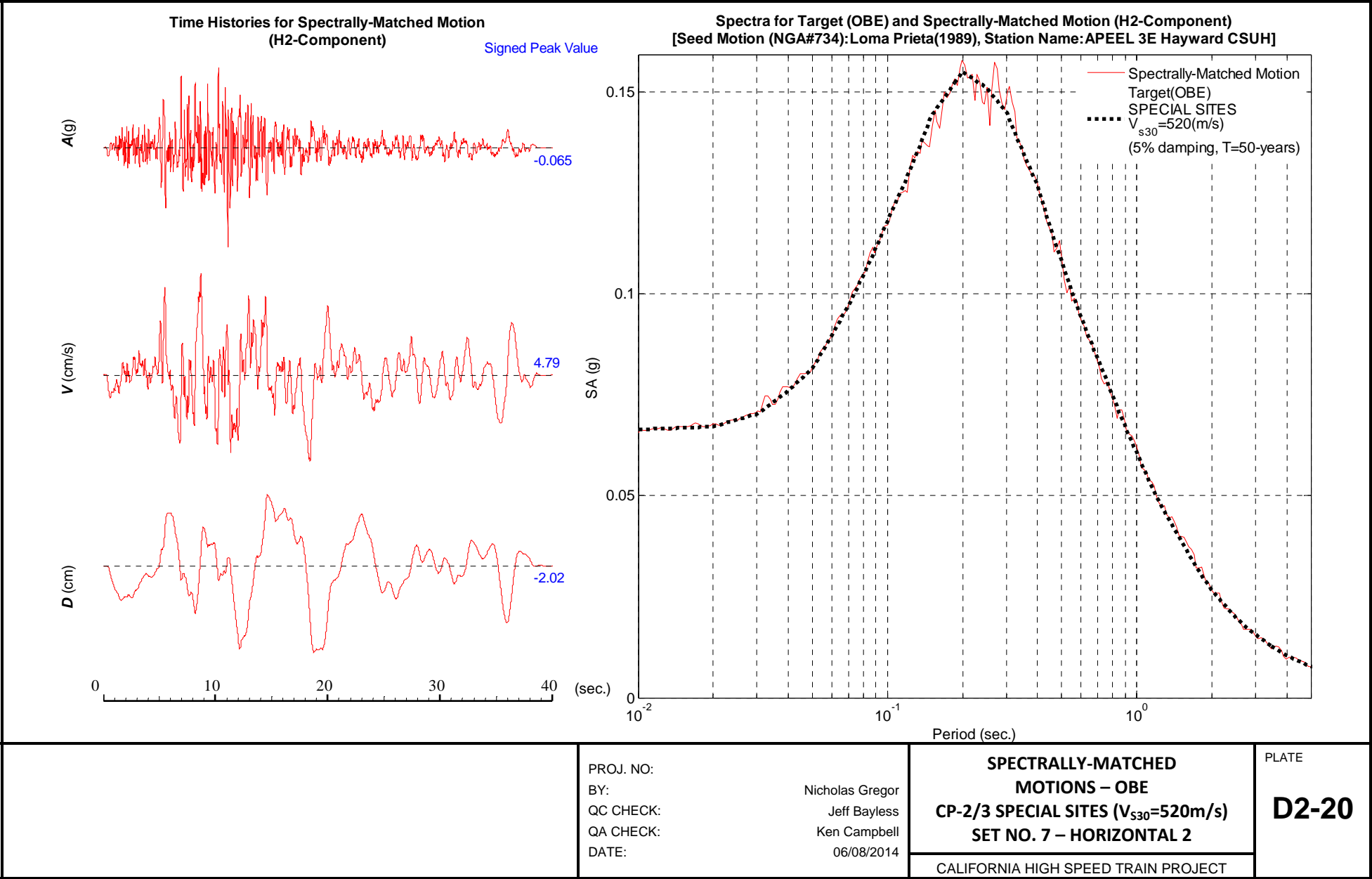


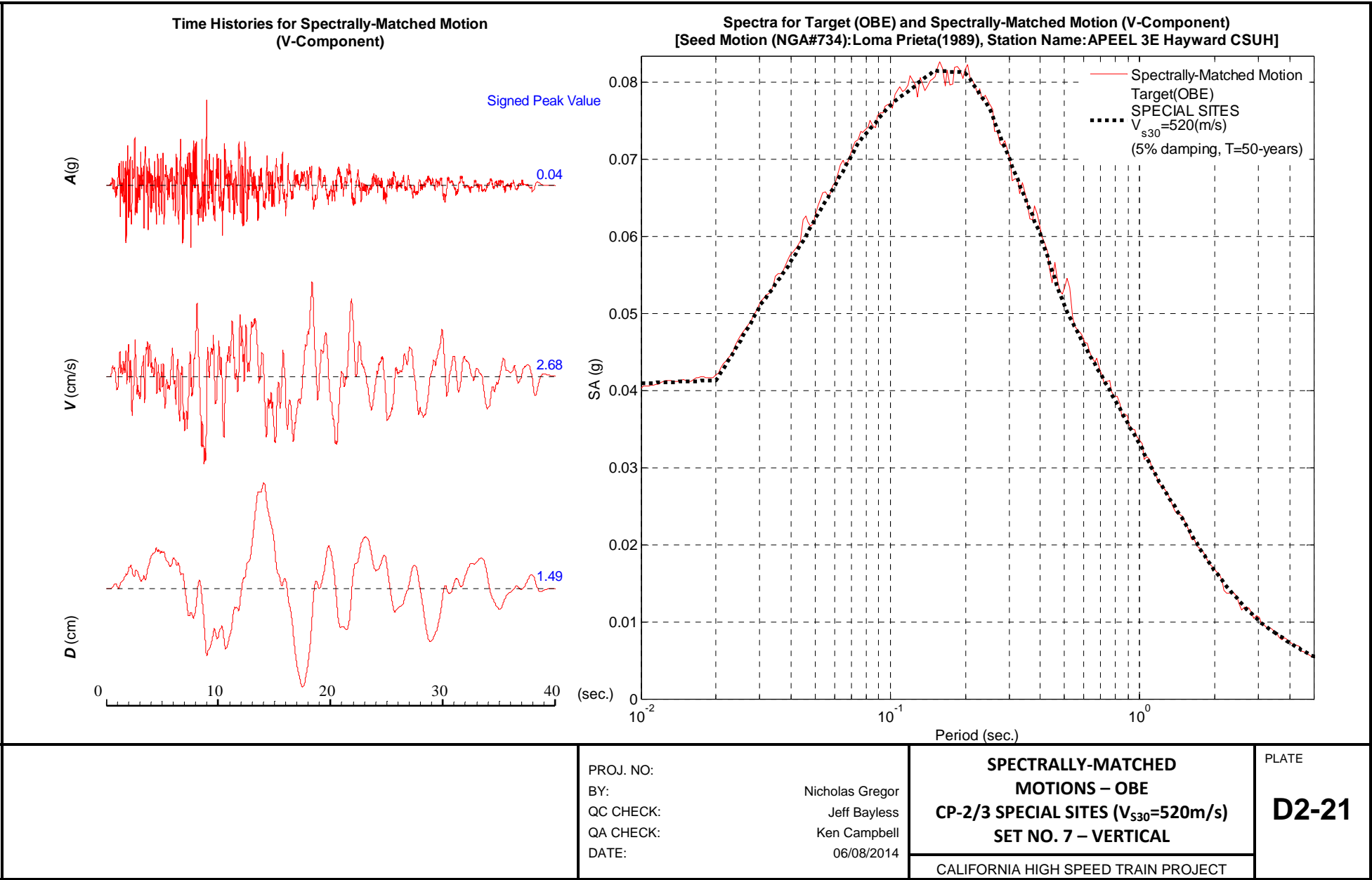




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RFP No.: 13-57 – Addendum No. 2 - 06/30/2014

**Table D.4:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for CP-2/3 Special Sites ( $V_{S30}=760$  m/s)**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2093	Nenana Mountain, Alaska	2002	TAPS Pump Station #09	6.70	104.73	0.056	3.377	1.706	0.057	3.187	1.563	0.037	2.161	1.045
2	1842	Hector Mine	1999	Wrightwood Post Office	7.13	118.71	0.057	4.157	3.935	0.055	3.144	1.601	0.036	2.376	1.581
3	929	Big Bear-01	1992	Salton City	6.46	129.76	0.056	4.083	1.357	0.057	3.641	0.973	0.036	2.508	0.797
4	3129	Chi-Chi, Taiwan-05	1999	TAP051	6.20	139.34	0.057	3.720	1.284	0.056	3.078	1.206	0.037	2.187	0.841
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.053	3.750	1.547	0.057	4.814	2.252	0.035	2.955	1.261
6	1766	Hector Mine	1999	Baker Fire Station	7.13	64.79	0.056	3.876	1.588	0.057	2.914	1.565	0.036	2.436	1.186
7	734	Loma Prieta	1989	APEEL 3E Hayward CSUH	6.93	52.53	0.055	2.622	1.820	0.056	3.541	1.583	0.036	2.435	1.317

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06/08/2014

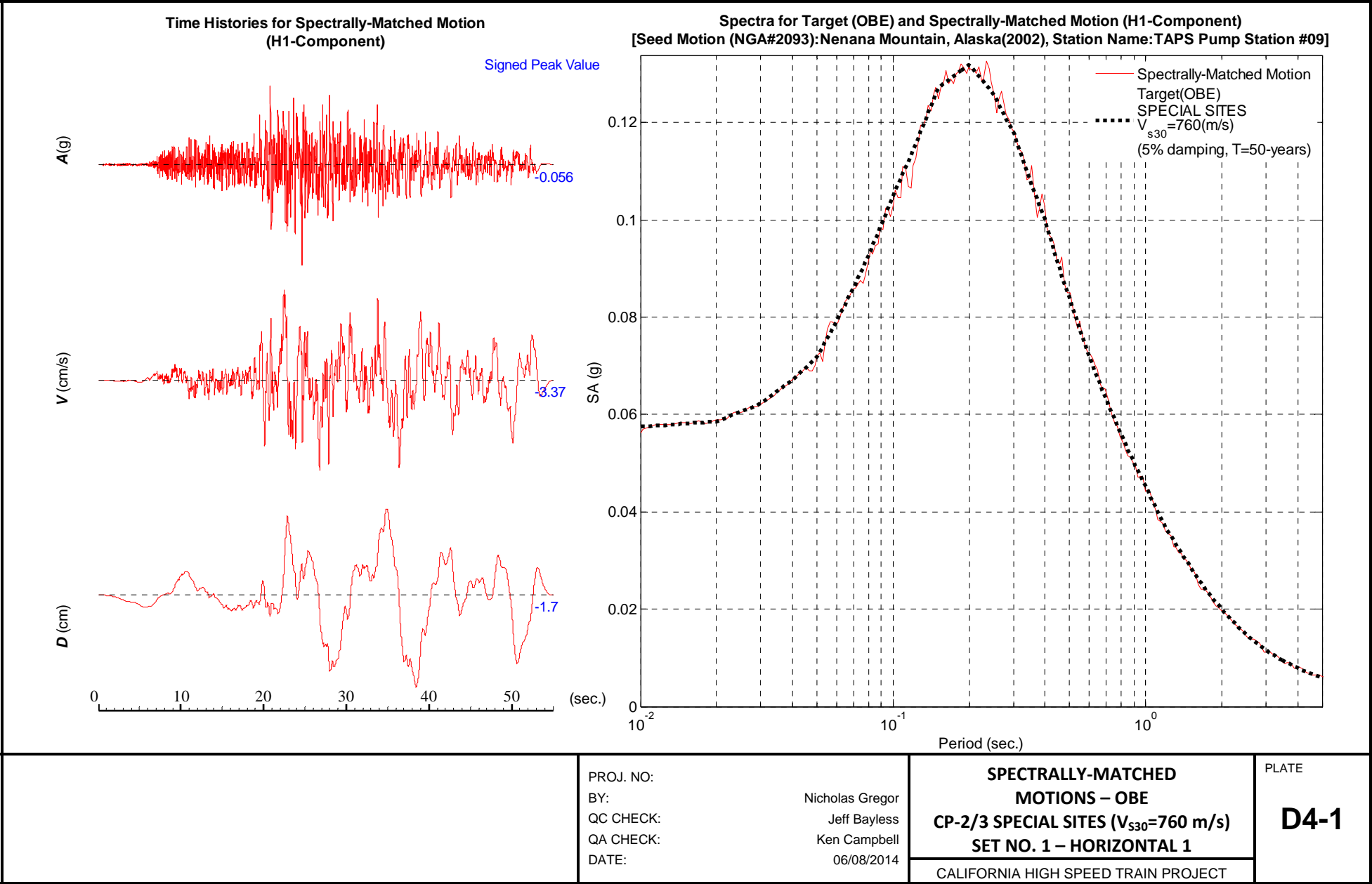
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OBE – CP-2/3 SPECIAL SITES ( $V_{S30}=760$  m/s)**

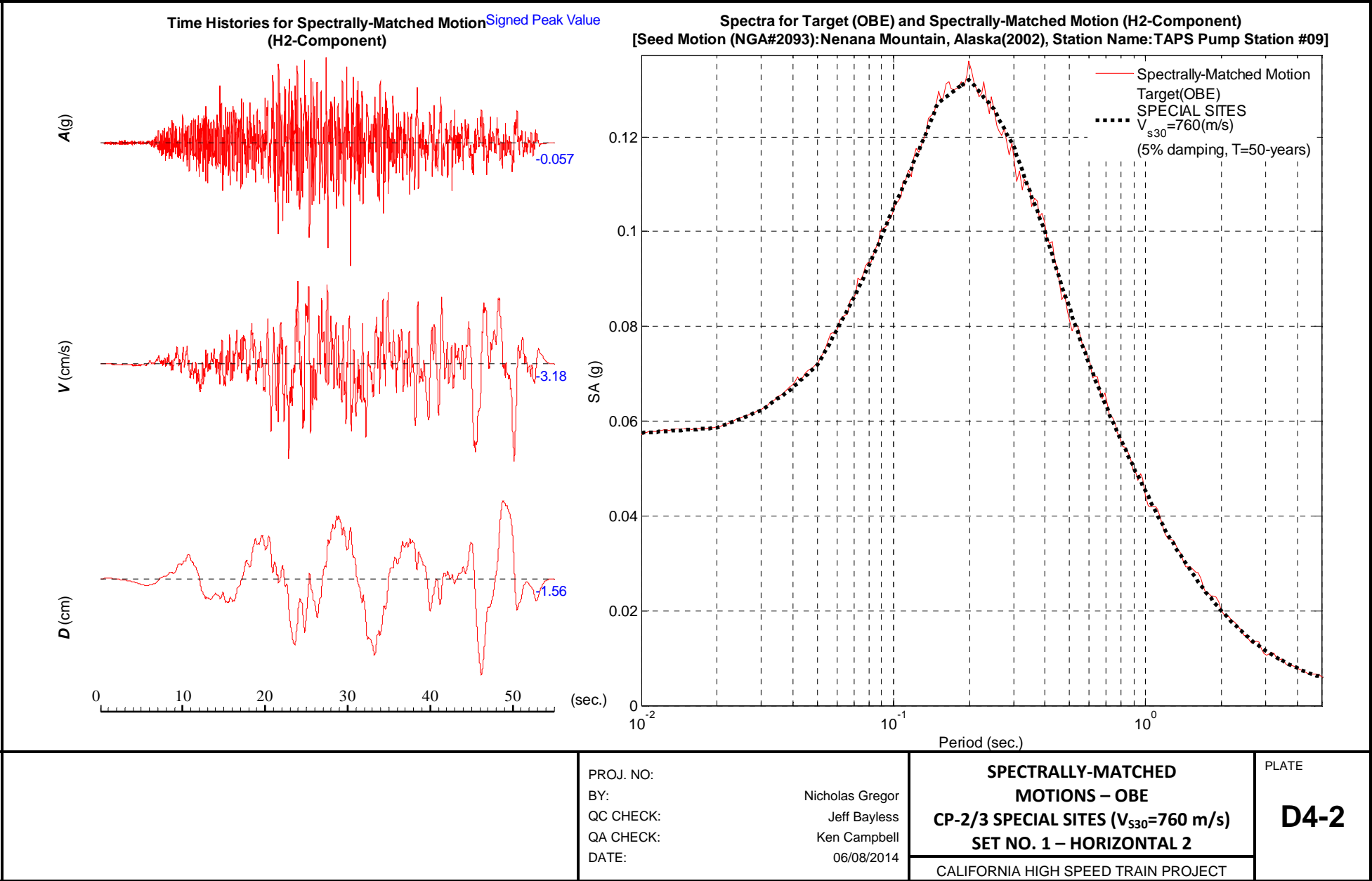
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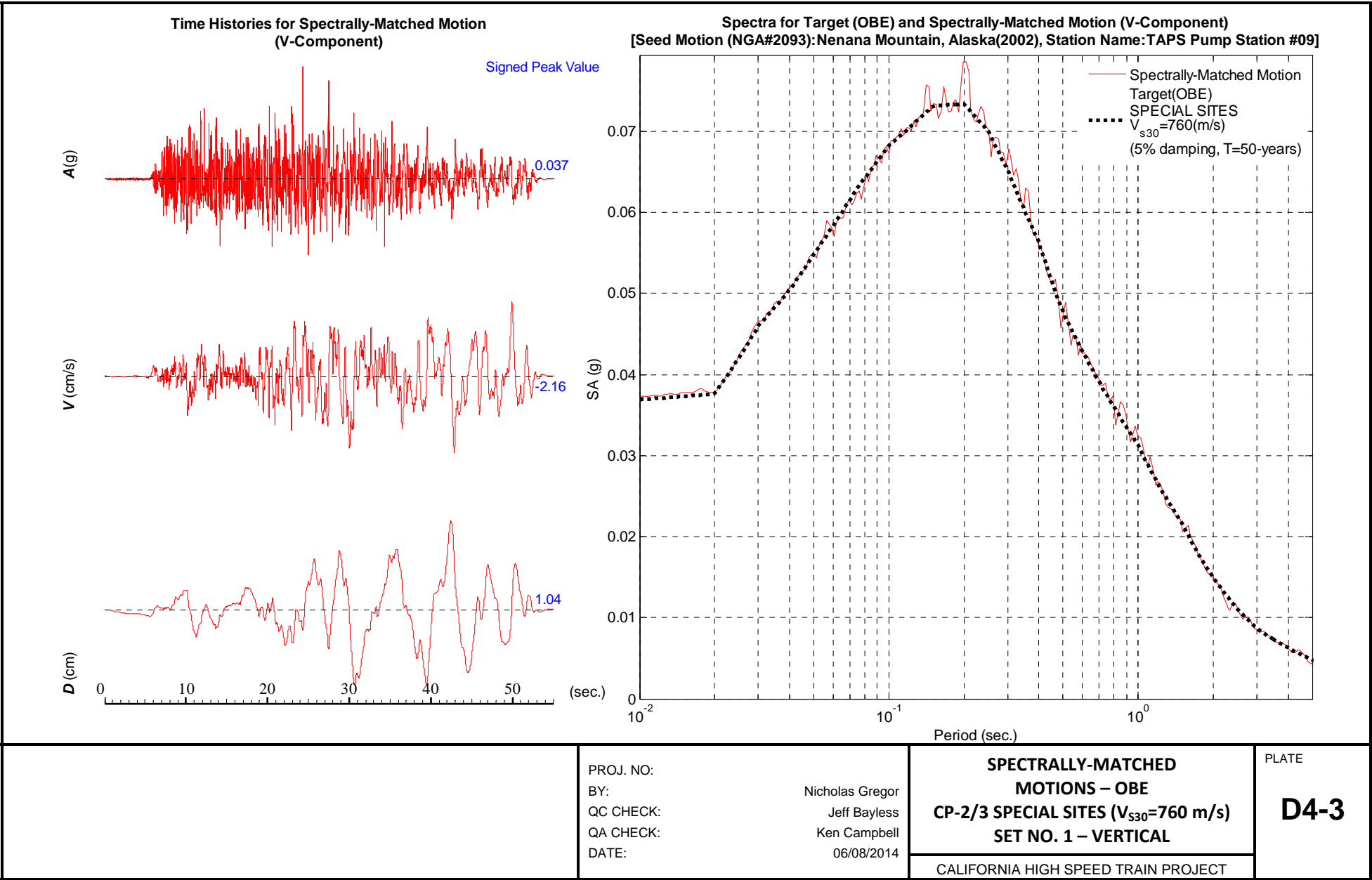
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**D4-0**

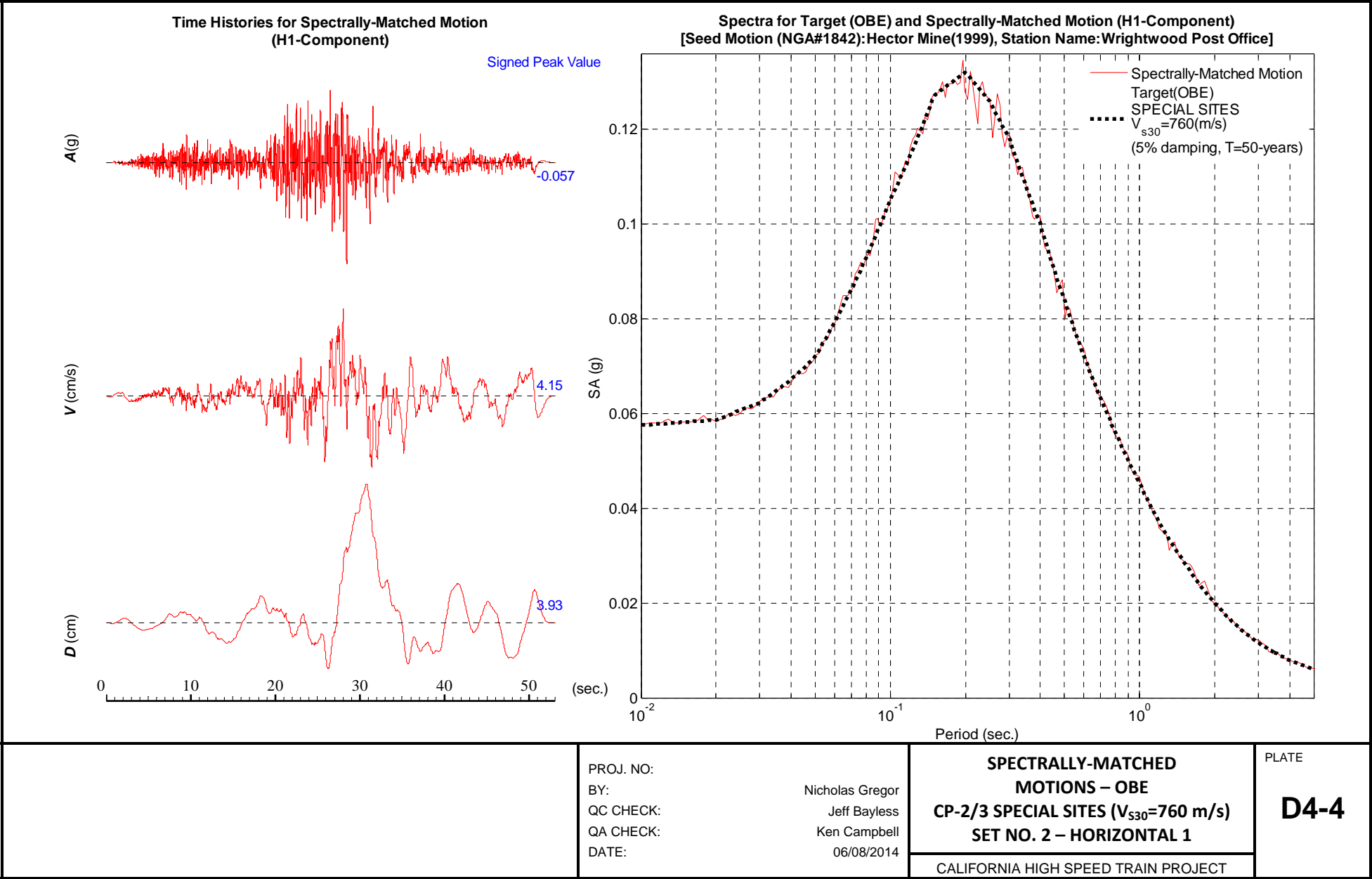
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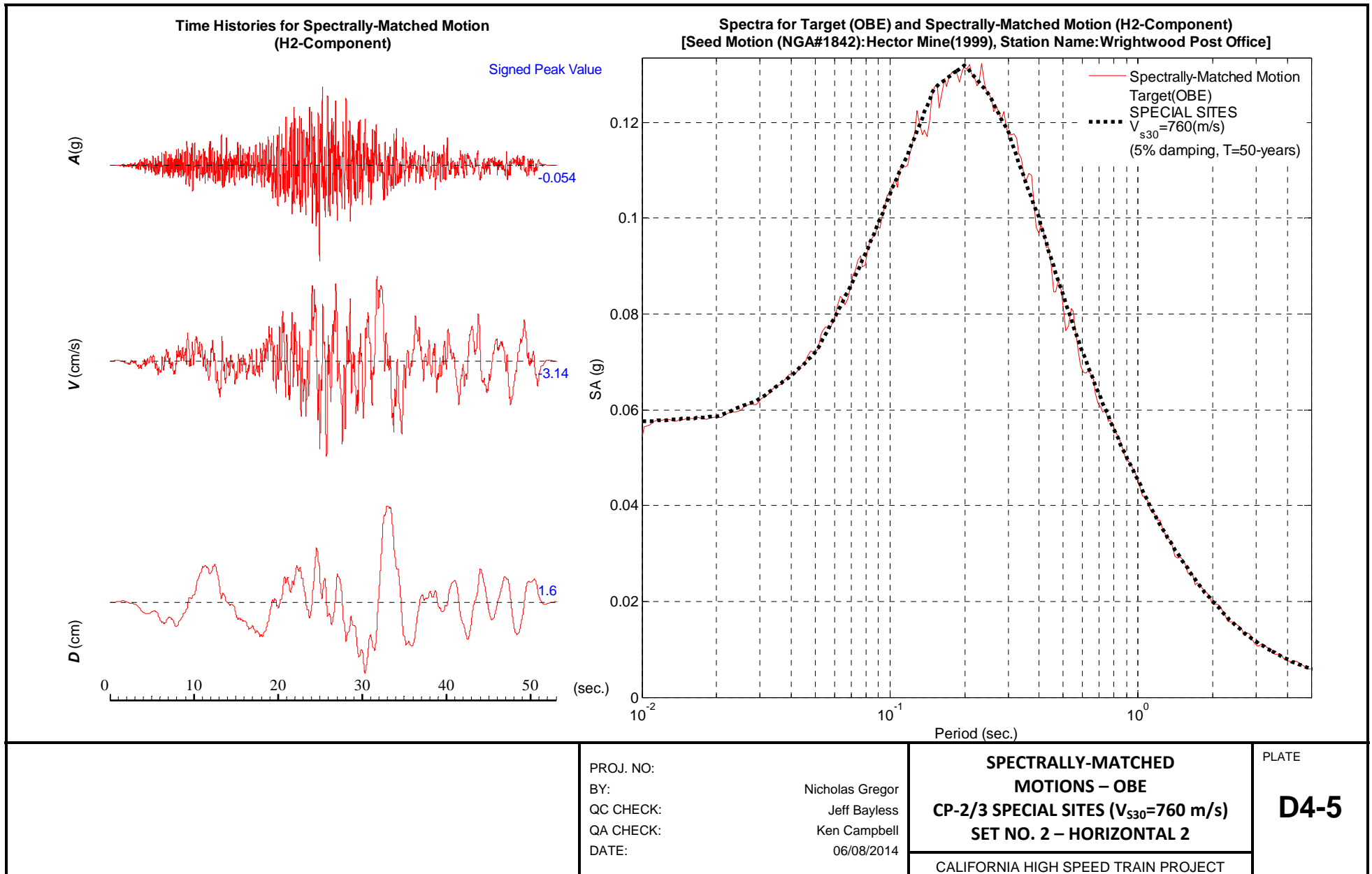




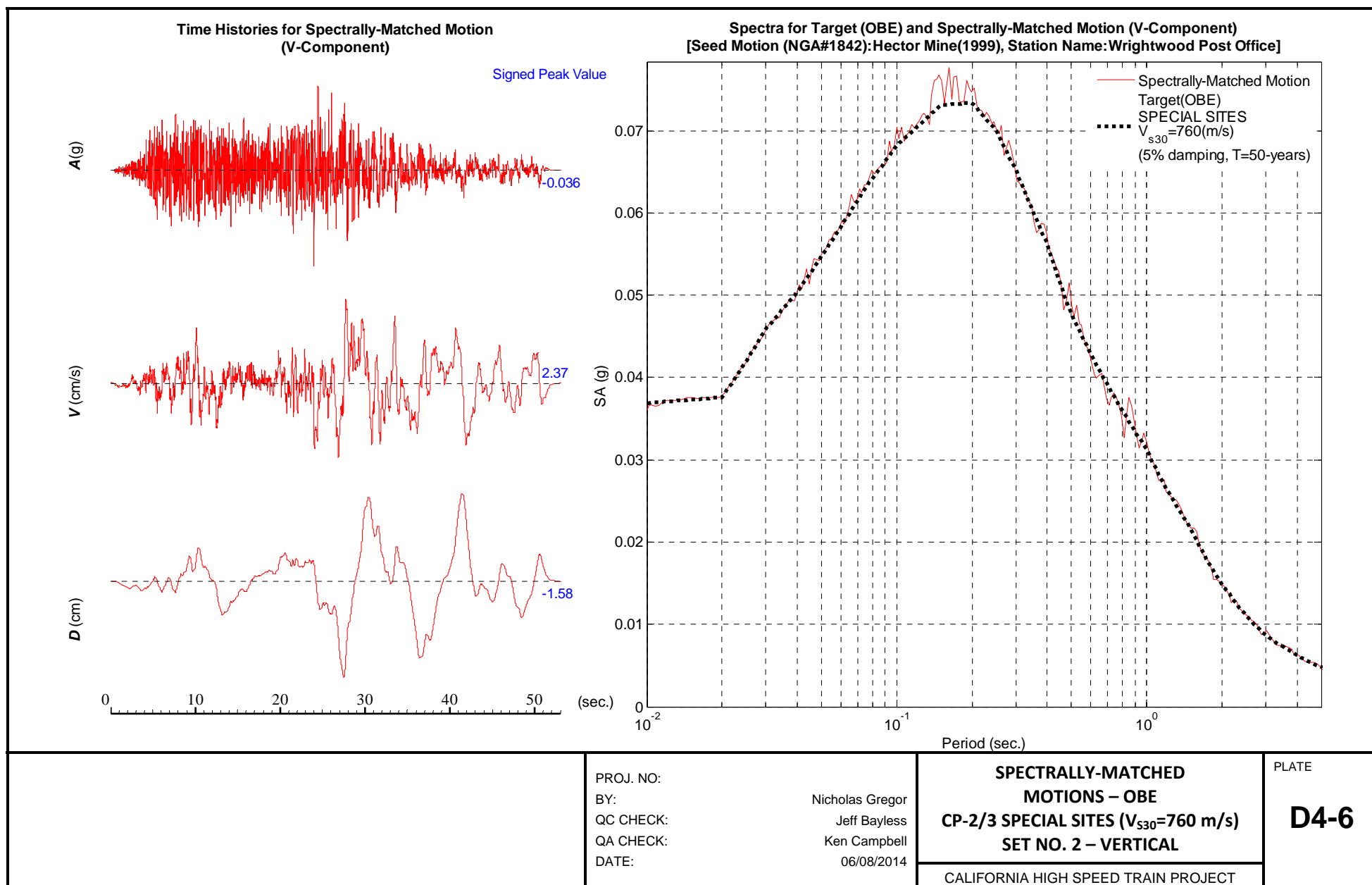
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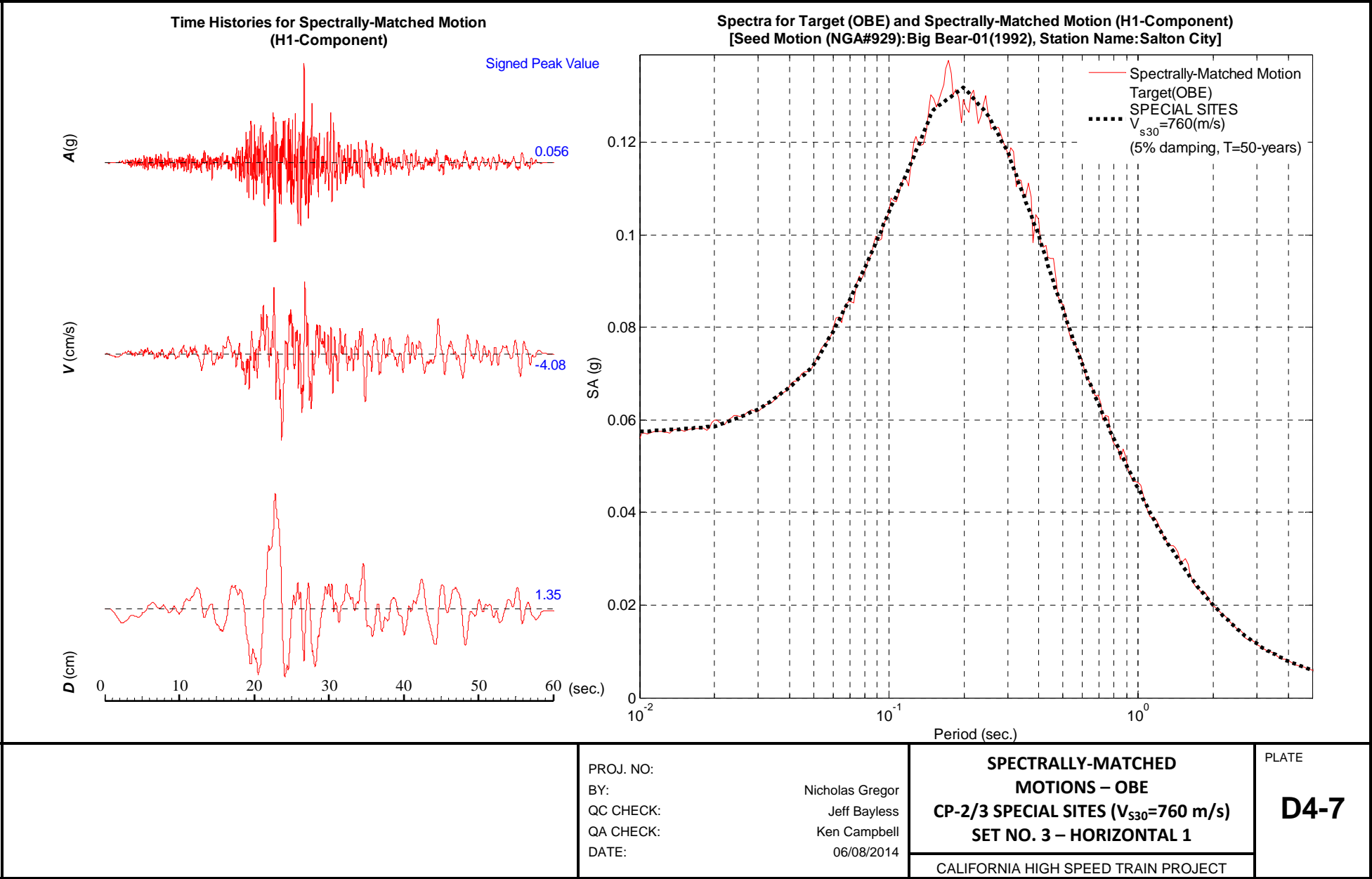


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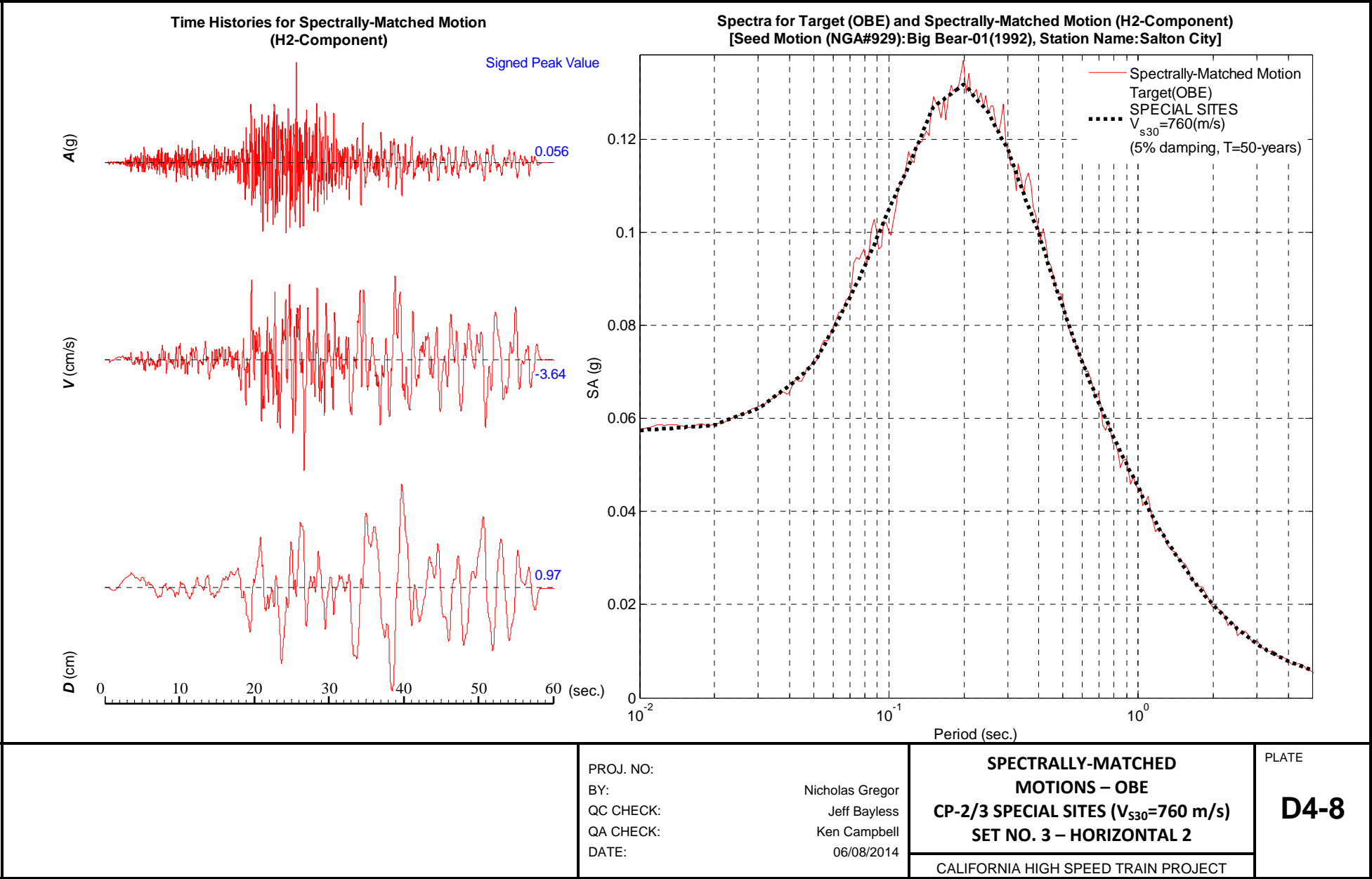


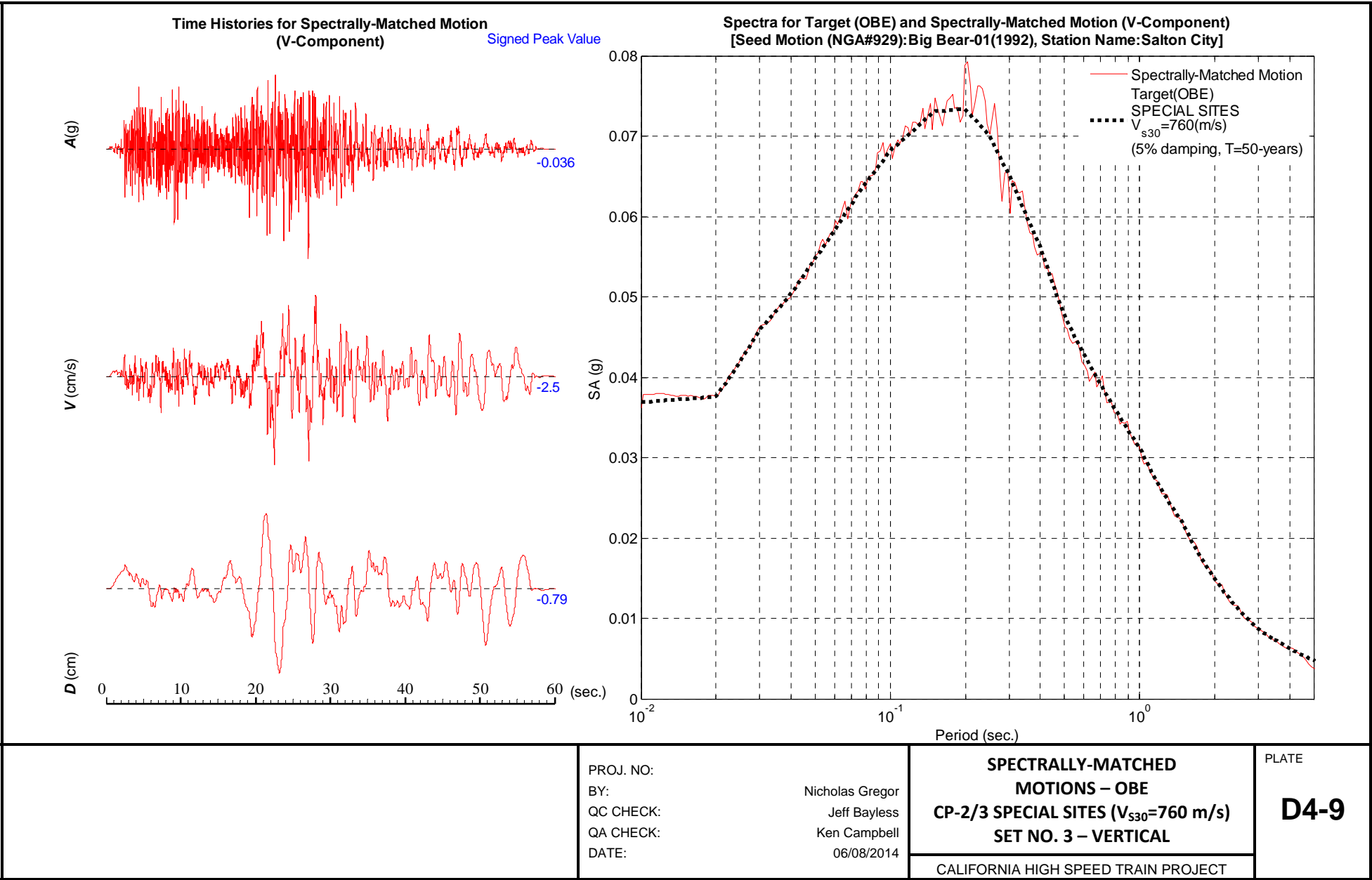




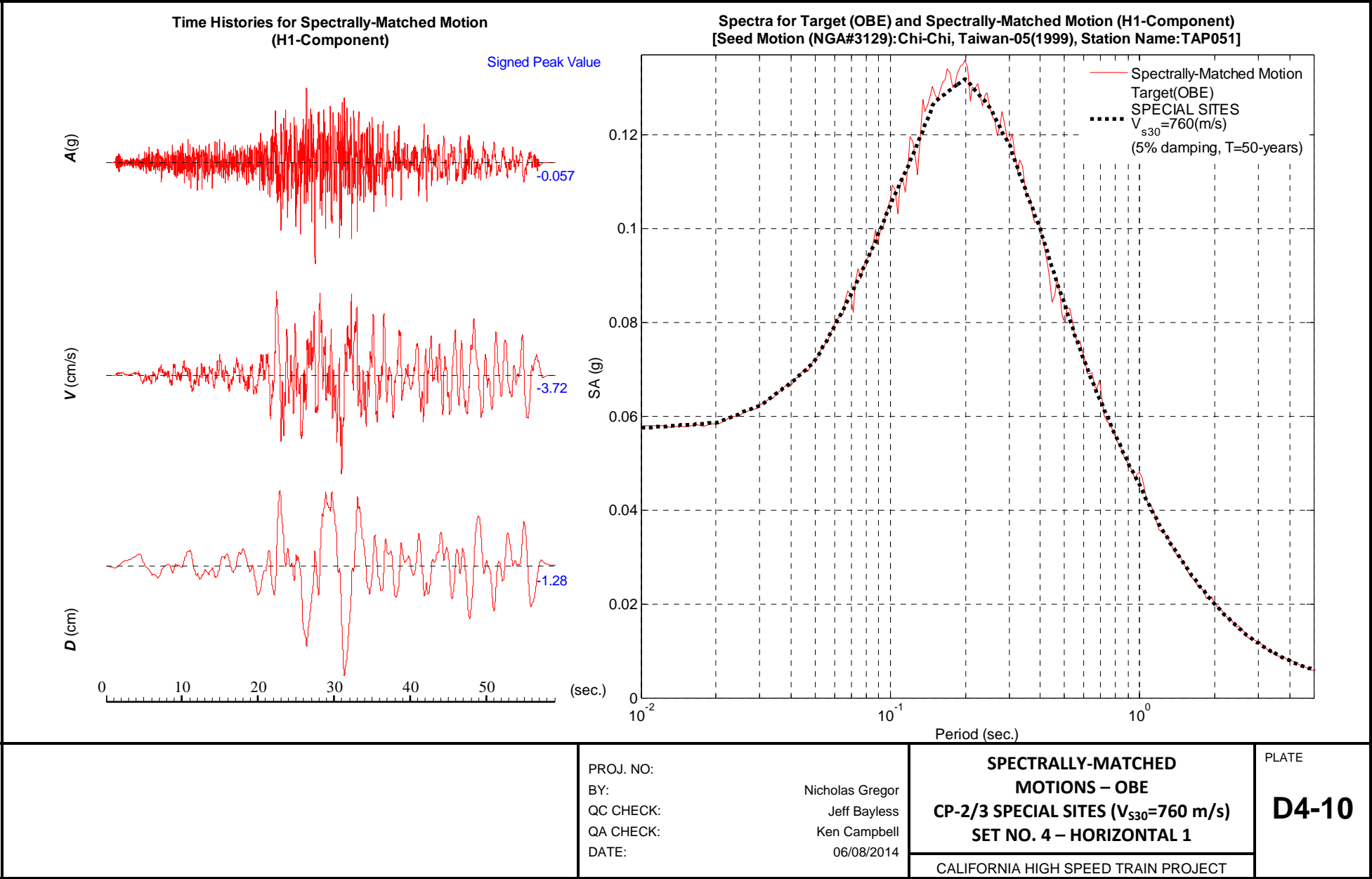


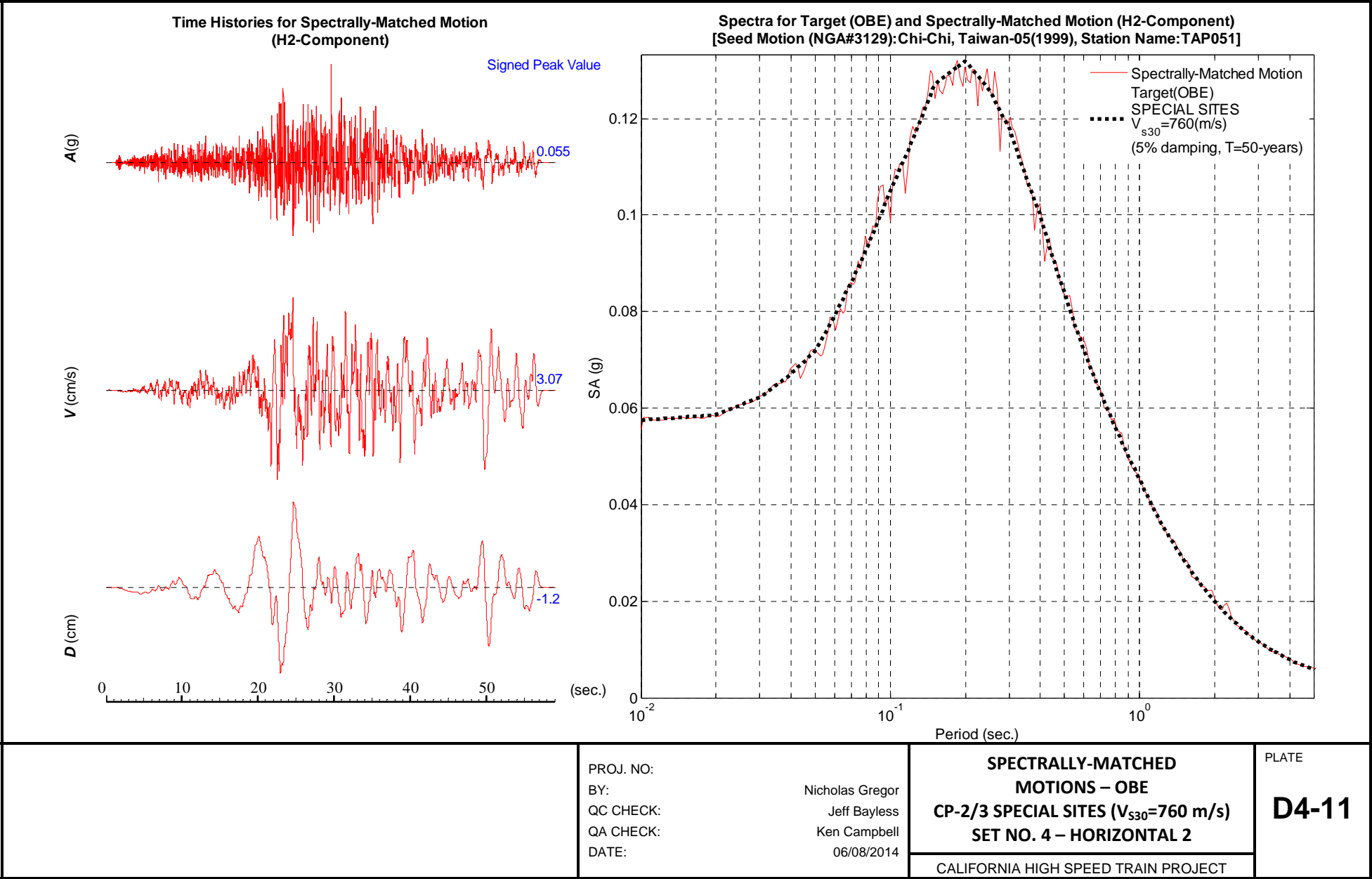
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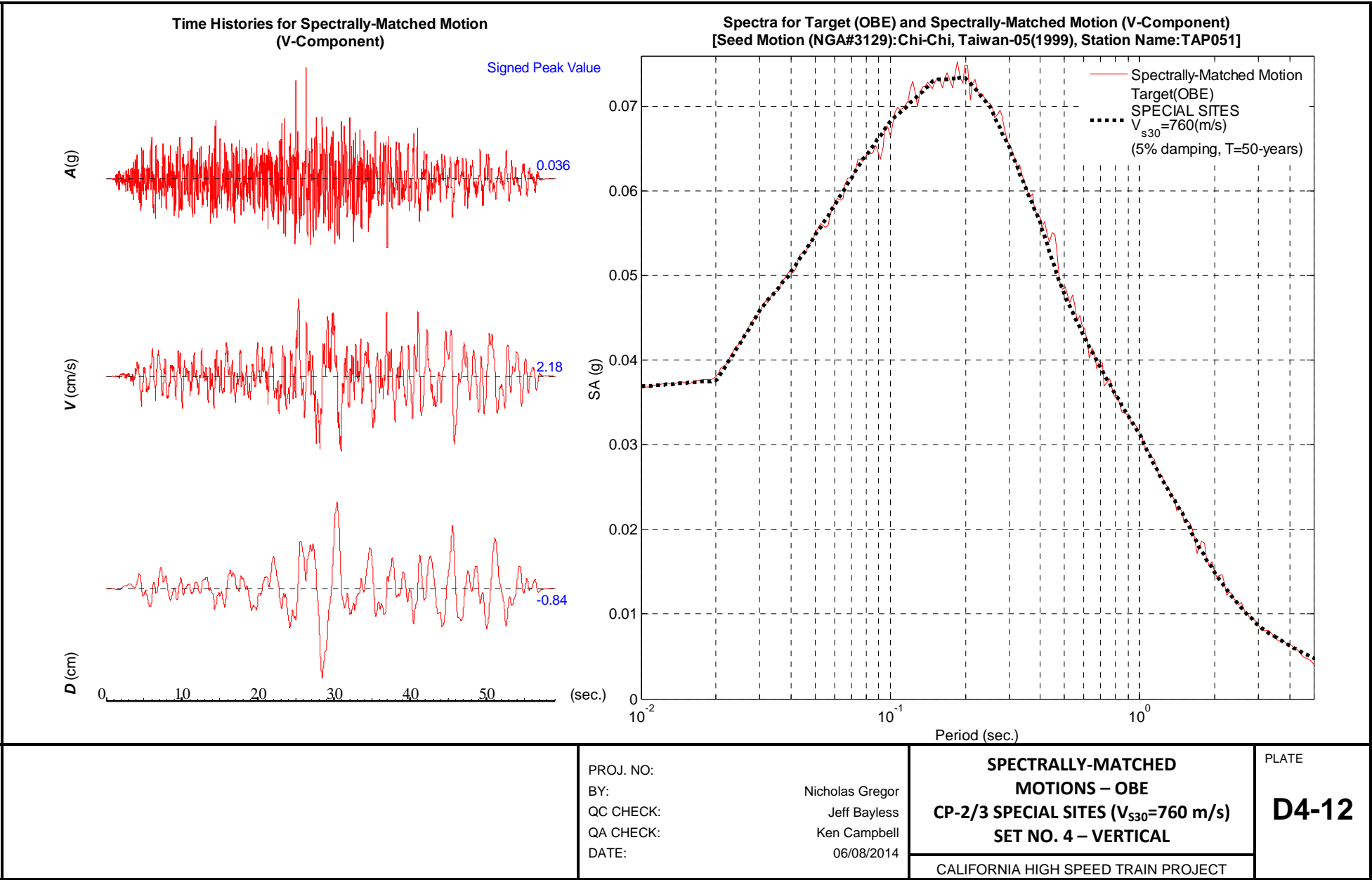


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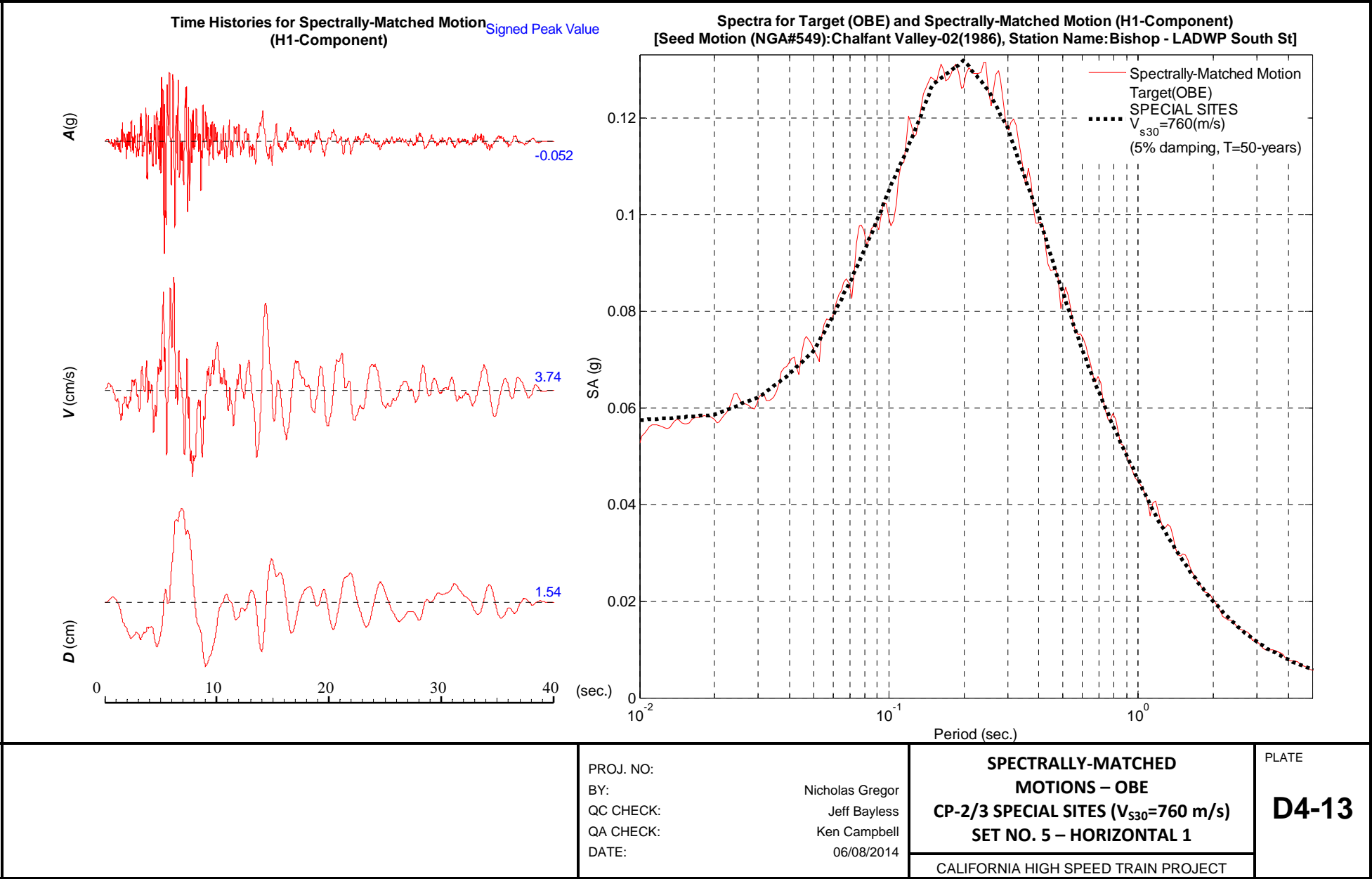




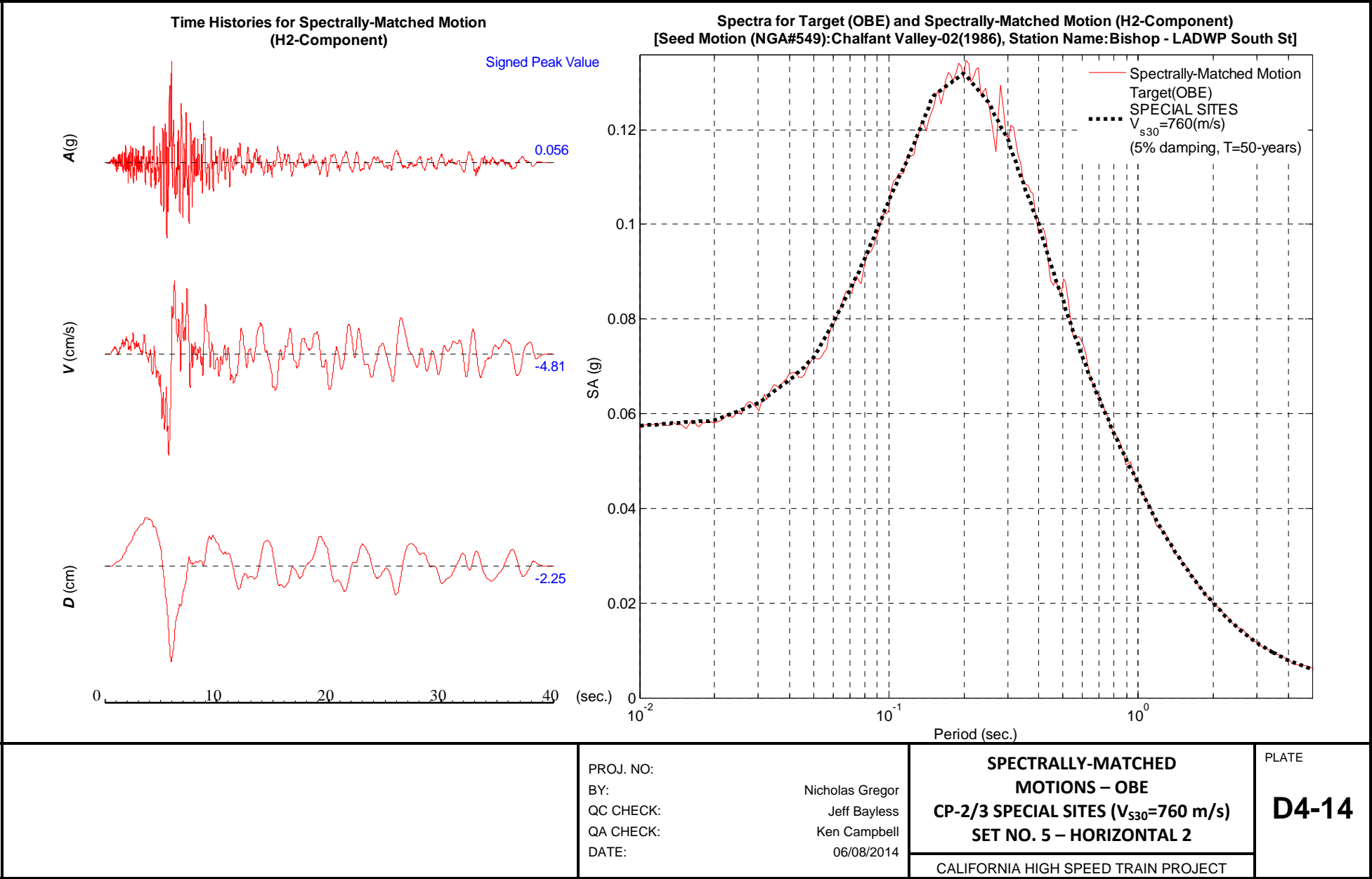
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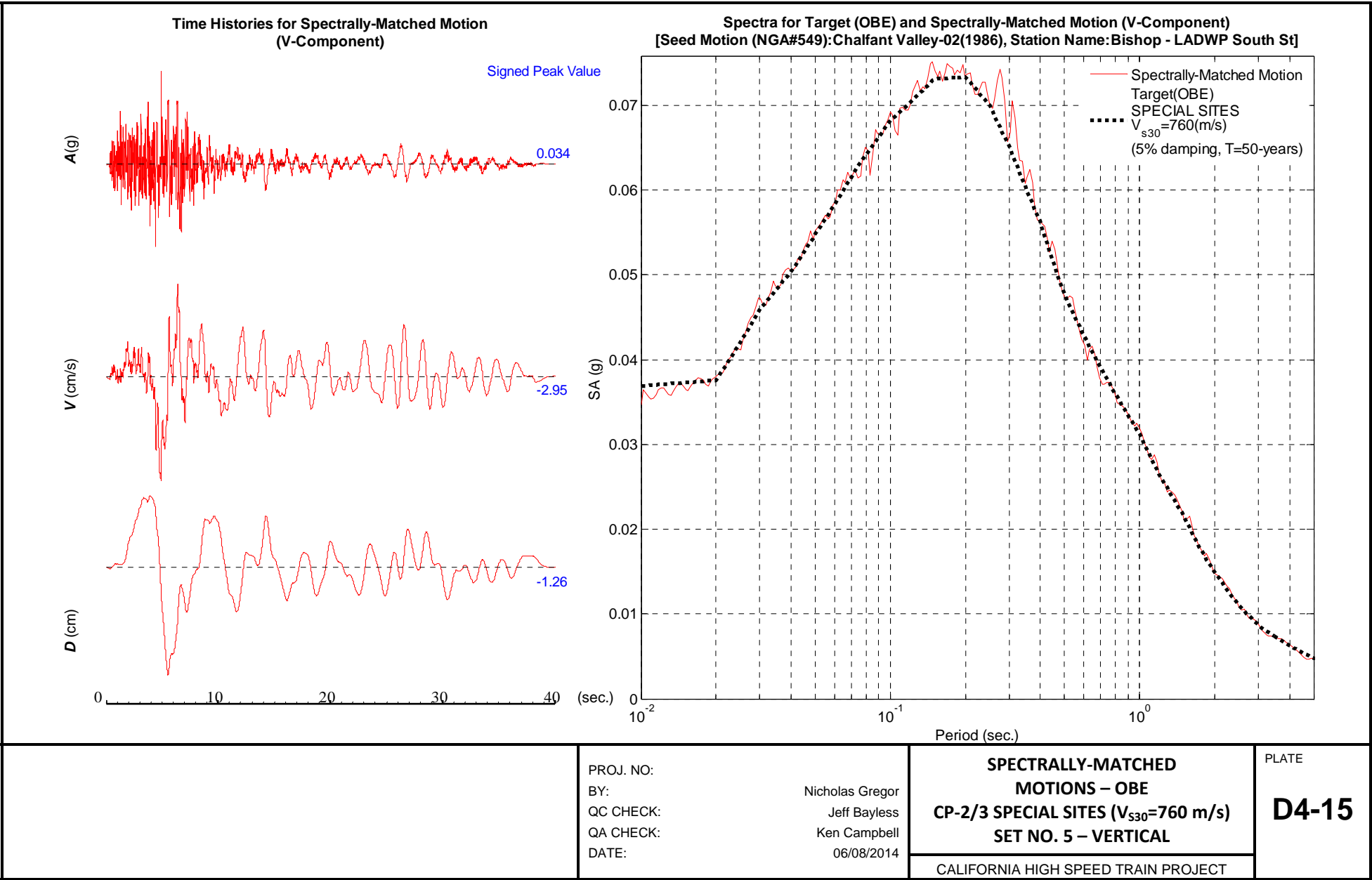
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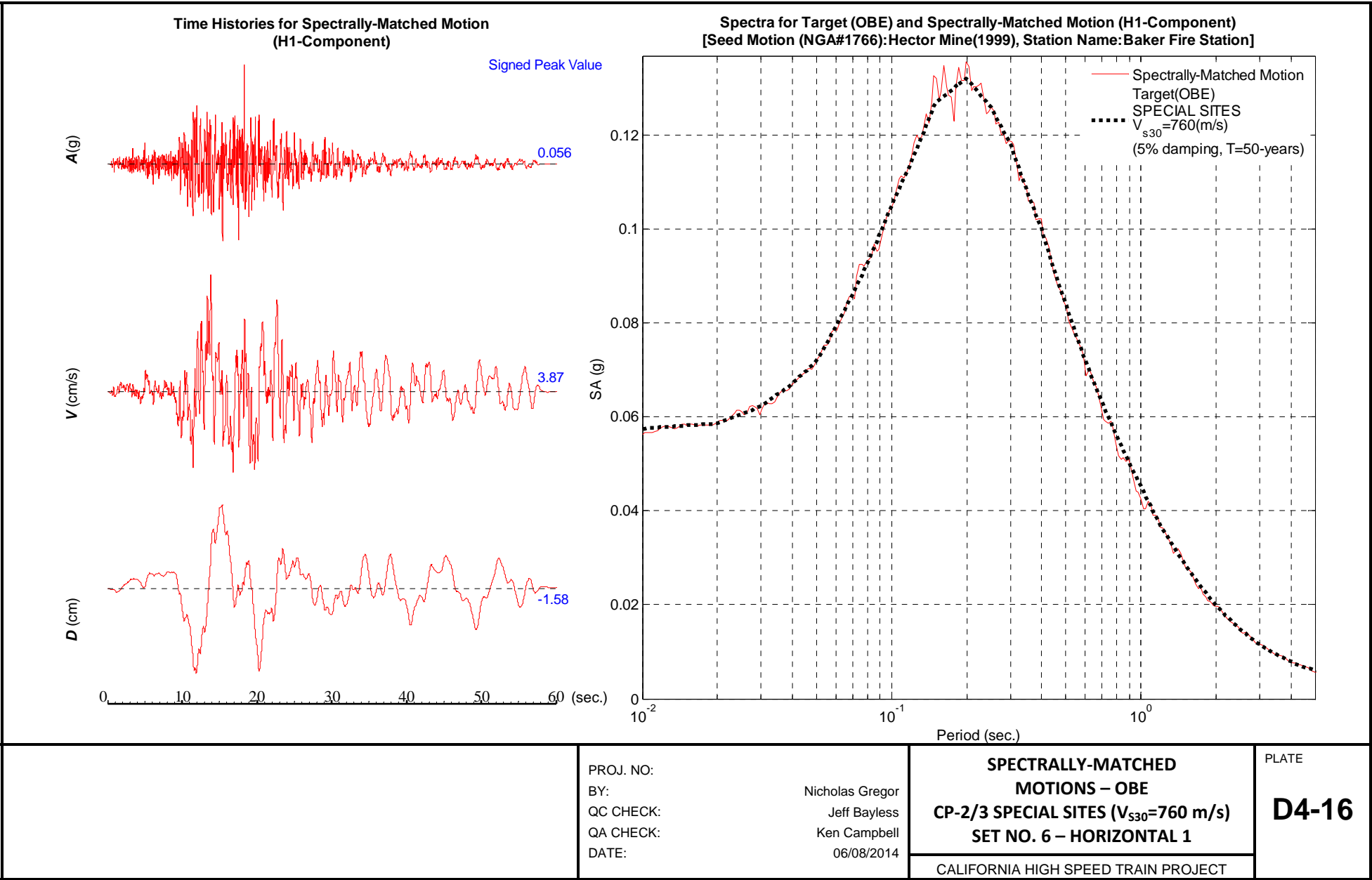


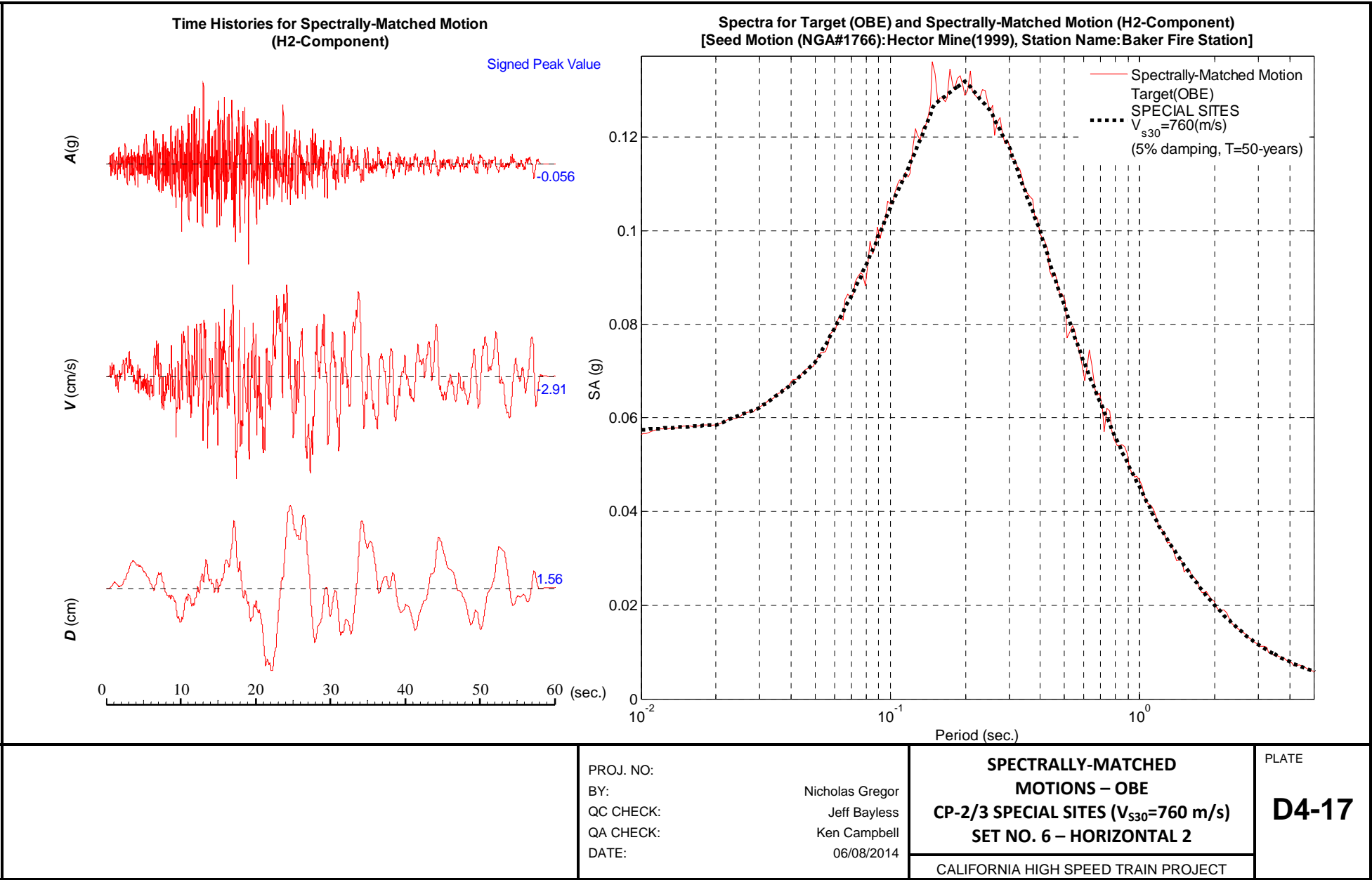




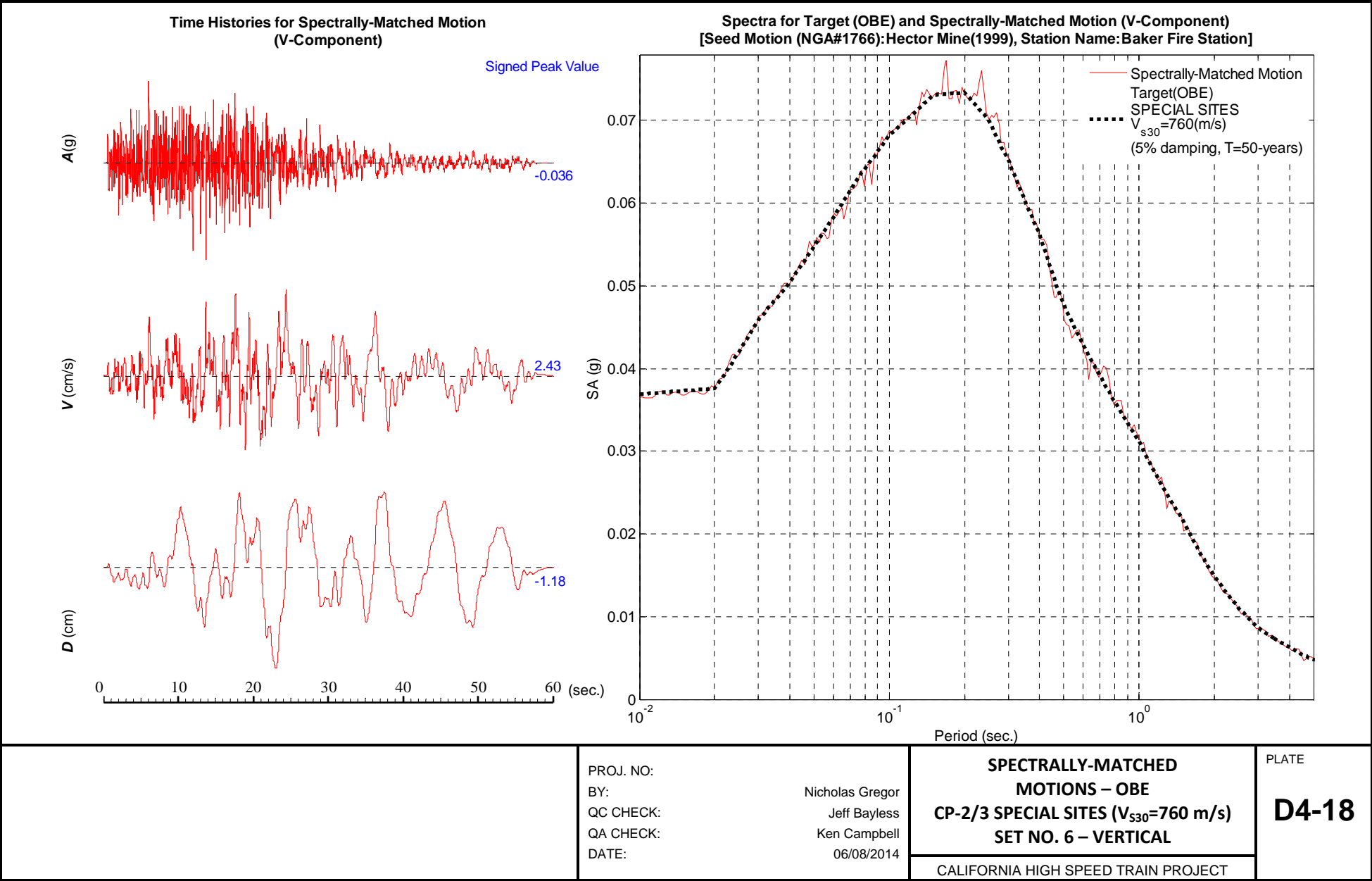
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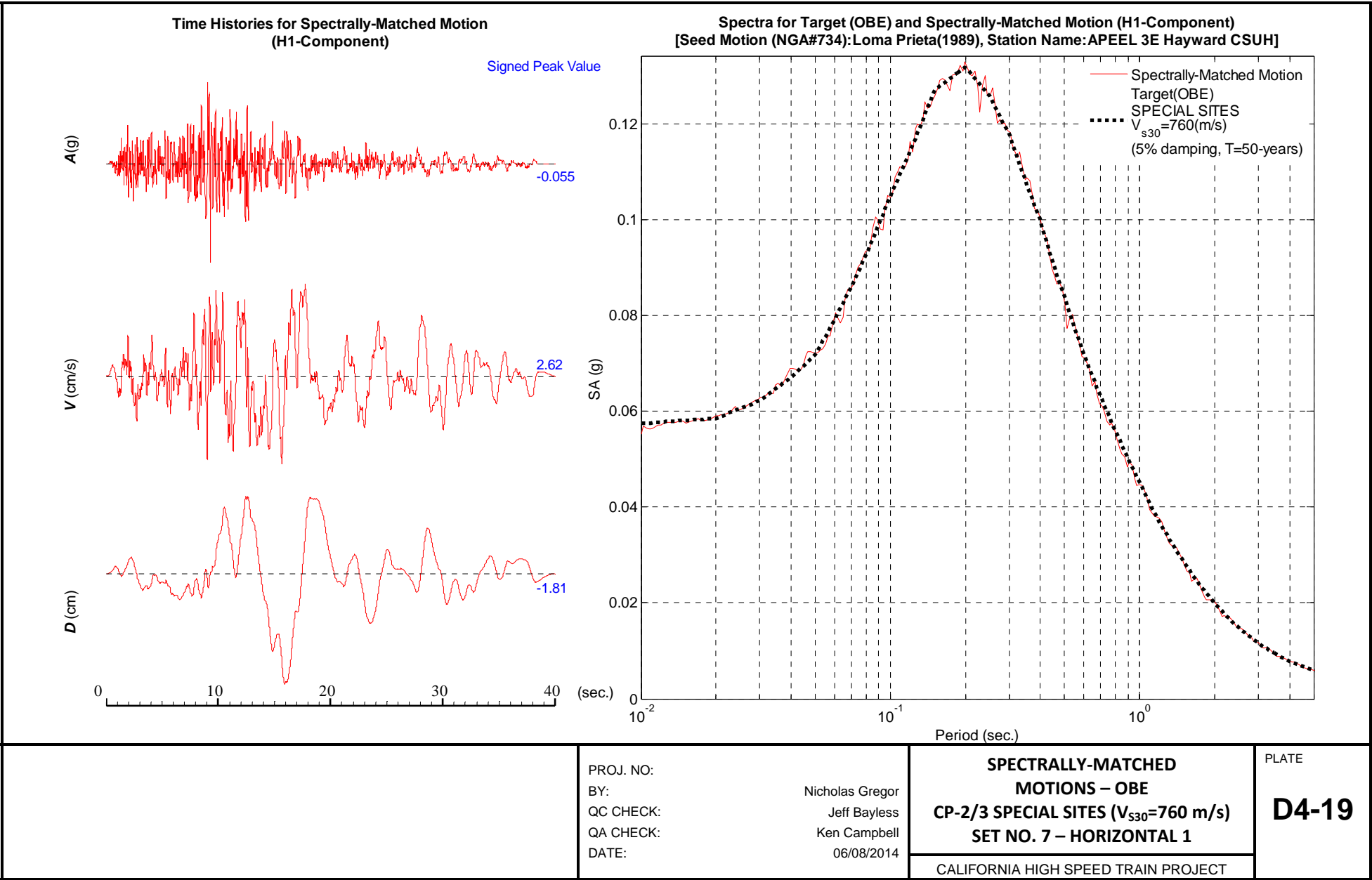




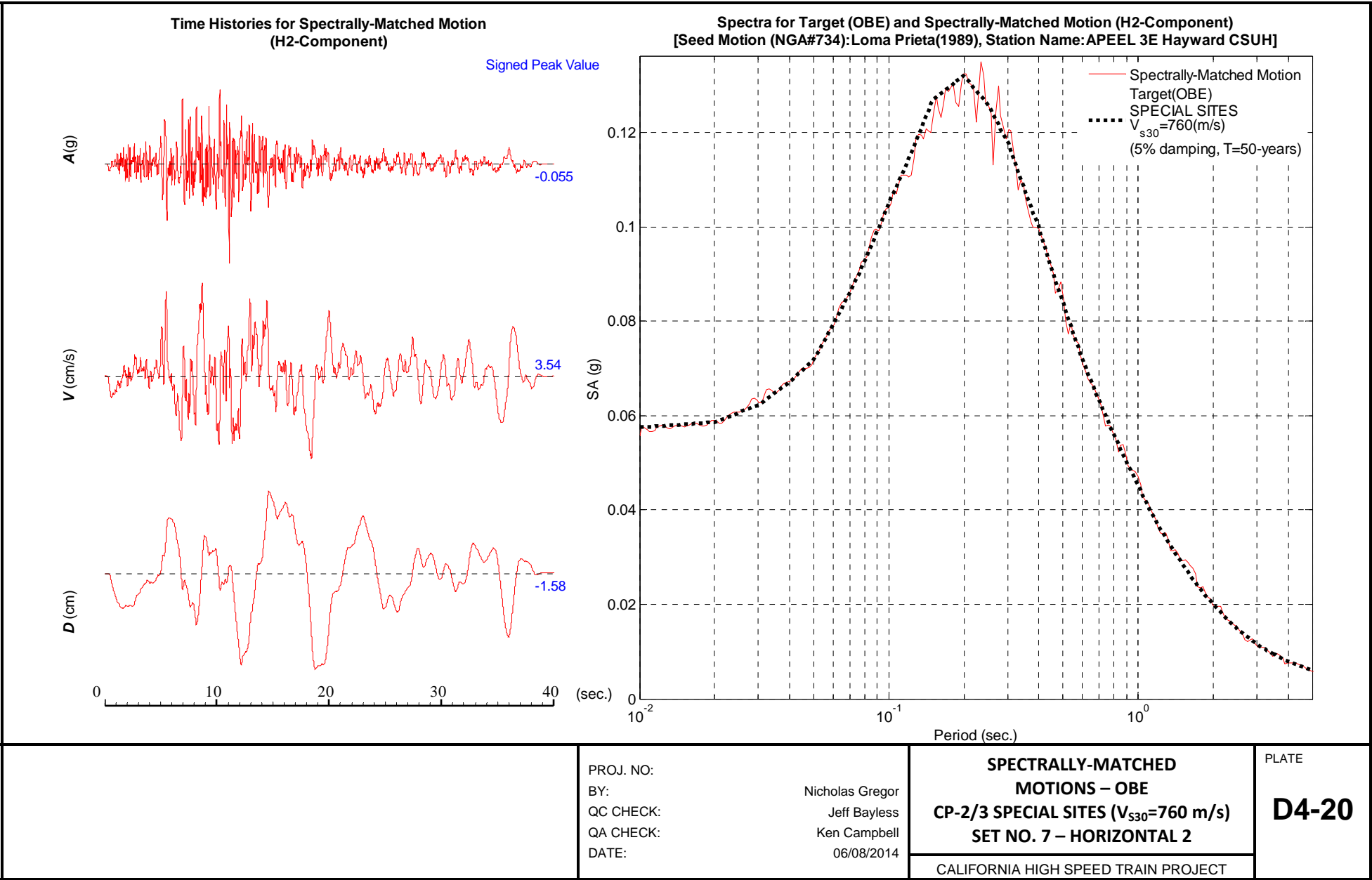


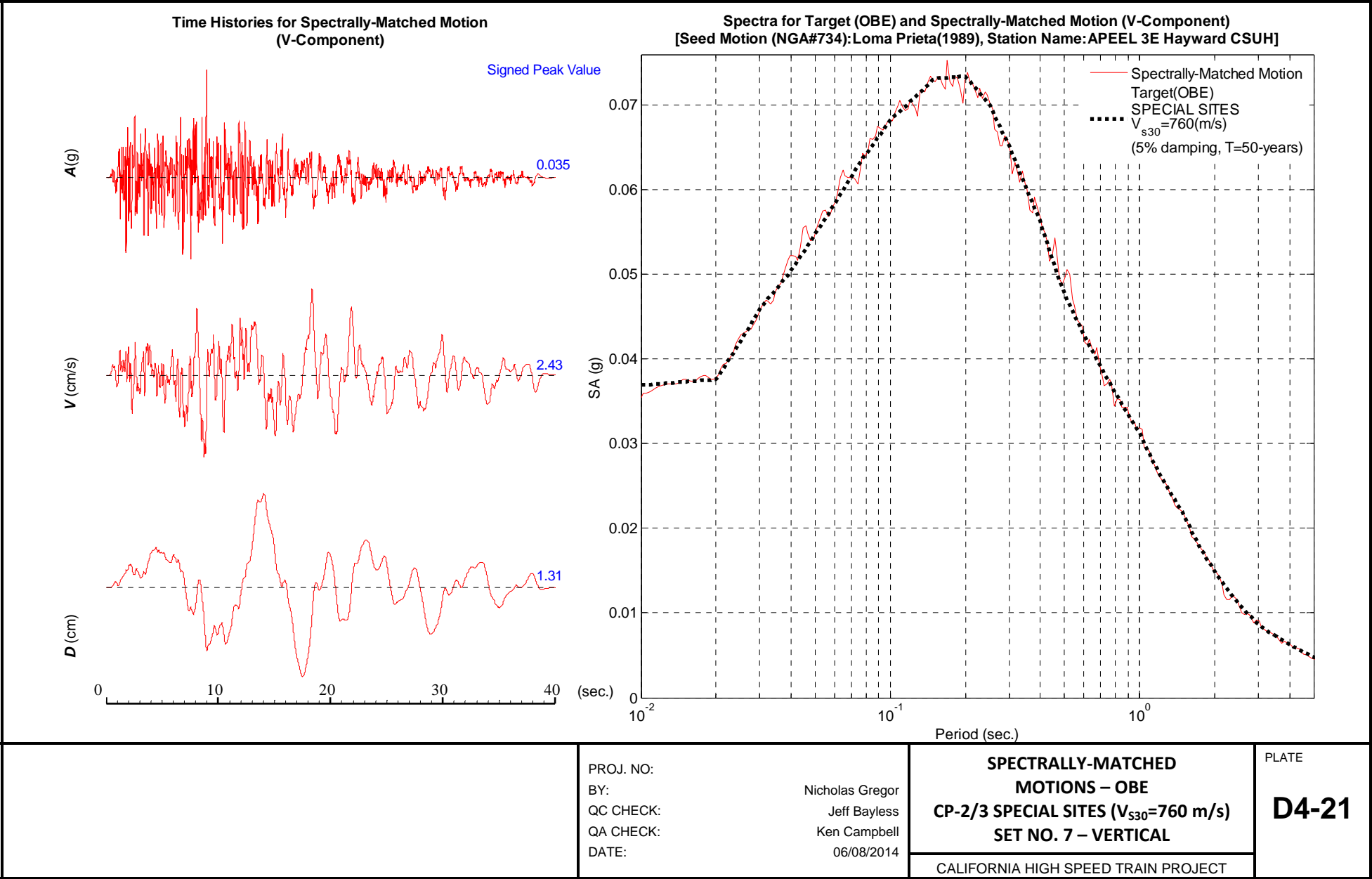
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**Table D.6:** Ground Motion Metrics for Selected Seed and Spectrally-Matched Motions for **OBE Design Level for CP-2/3 Special Sites ( $V_{S30}=1220$  m/s)**

Set	NGA #	Selected Seed Motions					Spectrally-Matched Motions								
		Earthquake Name	Year	Station Name	Mw	R	PGA H1 (g)	PGV H1 (cm/s)	PGD H1 (cm)	PGA H2 (g)	PGV H2 (cm/s)	PGD H2 (cm)	PGA V (g)	PGV V (cm/s)	PGD V (cm)
1	2093	Nenana Mountain, Alaska	2002	TAPS Pump Station #09	6.70	104.73	0.048	2.591	1.264	0.049	2.446	1.183	0.034	1.761	0.863
2	1842	Hector Mine	1999	Wrightwood Post Office	7.13	118.71	0.049	3.098	2.602	0.047	2.352	1.232	0.033	1.940	1.342
3	929	Big Bear-01	1992	Salton City	6.46	129.76	0.048	3.115	1.087	0.048	2.779	0.789	0.033	2.213	0.694
4	3129	Chi-Chi, Taiwan-05	1999	TAP051	6.20	139.34	0.048	2.969	0.997	0.047	2.364	0.936	0.034	1.878	0.692
5	549	Chalfant Valley-02	1986	Bishop - LADWP South St	6.19	17.17	0.046	2.837	1.176	0.046	3.654	1.729	0.033	2.523	1.111
6	1766	Hector Mine	1999	Baker Fire Station	7.13	64.79	0.048	3.080	1.229	0.049	2.222	1.209	0.034	2.097	0.987
7	734	Loma Prieta	1989	APEEL 3E Hayward CSUH	6.93	52.53	0.048	1.992	1.351	0.048	2.802	1.225	0.033	2.024	1.204

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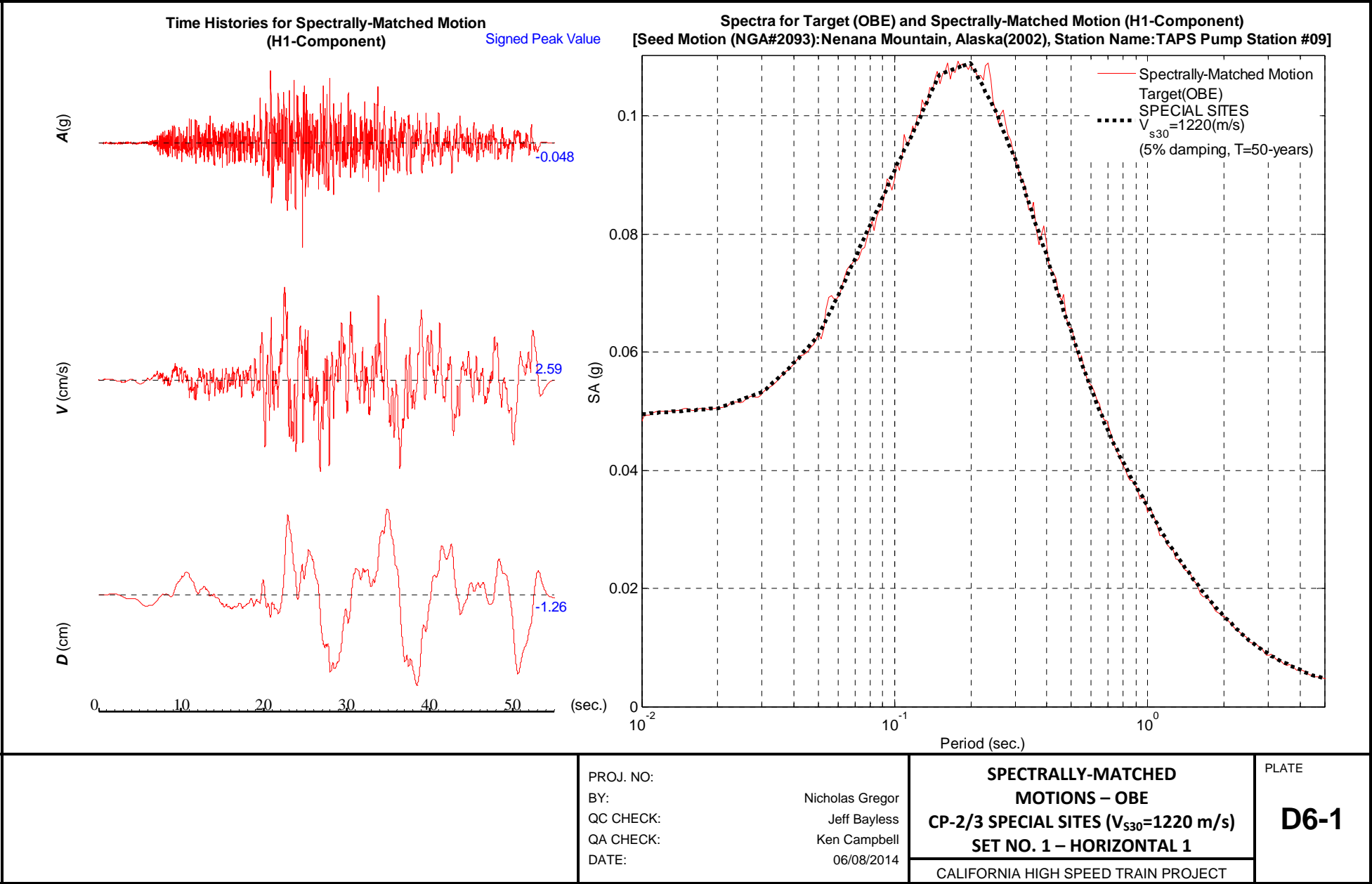
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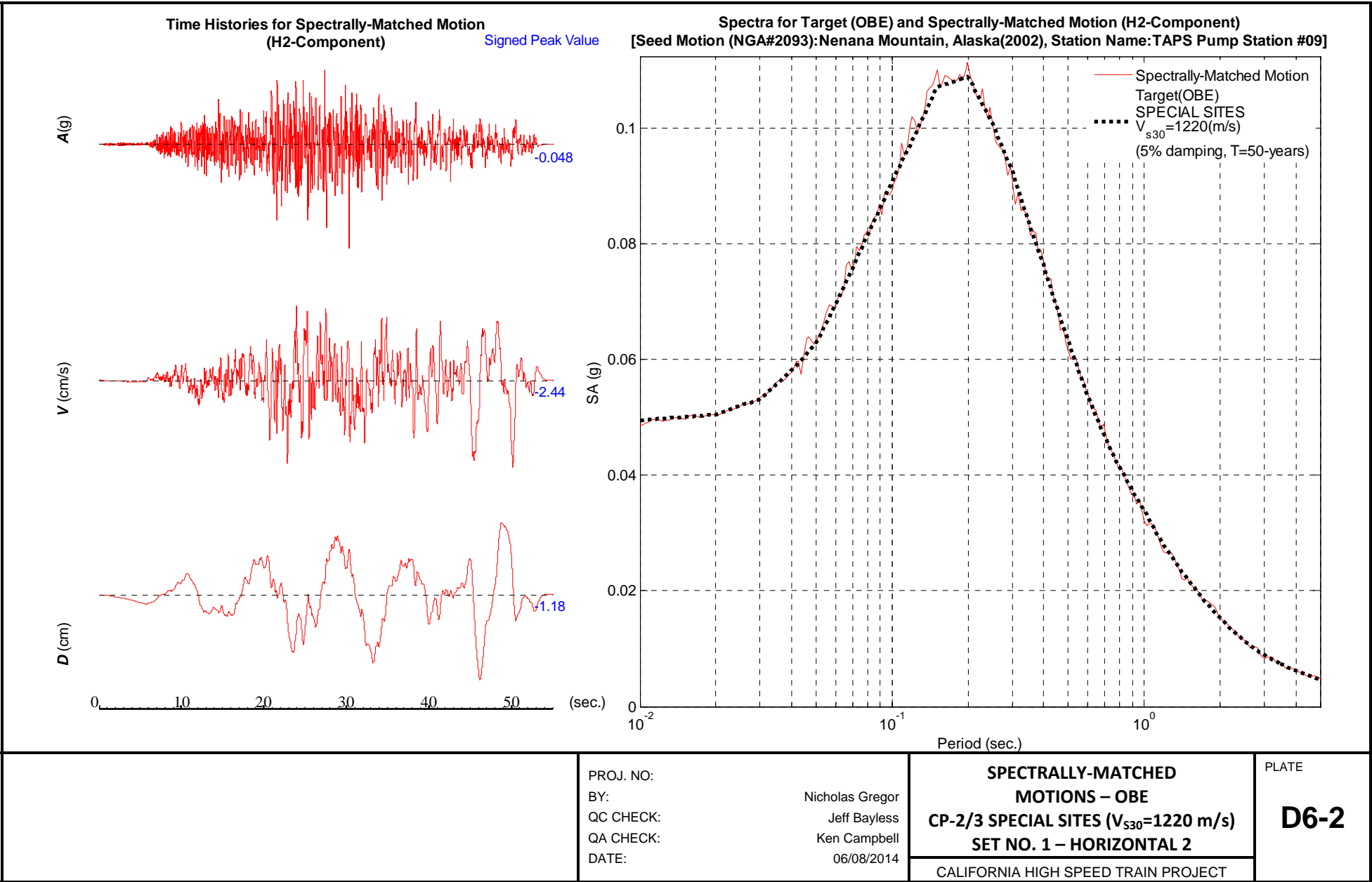
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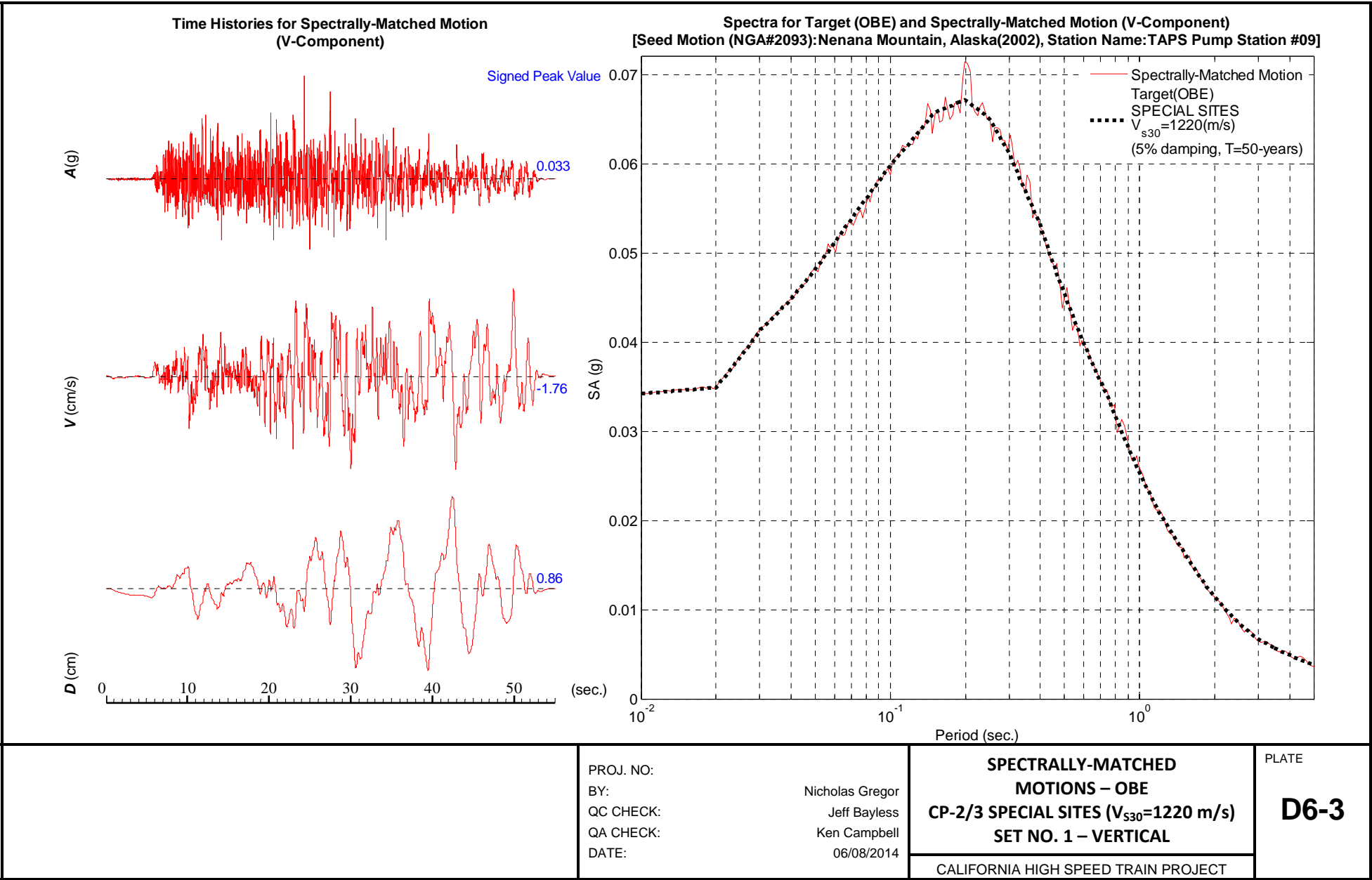
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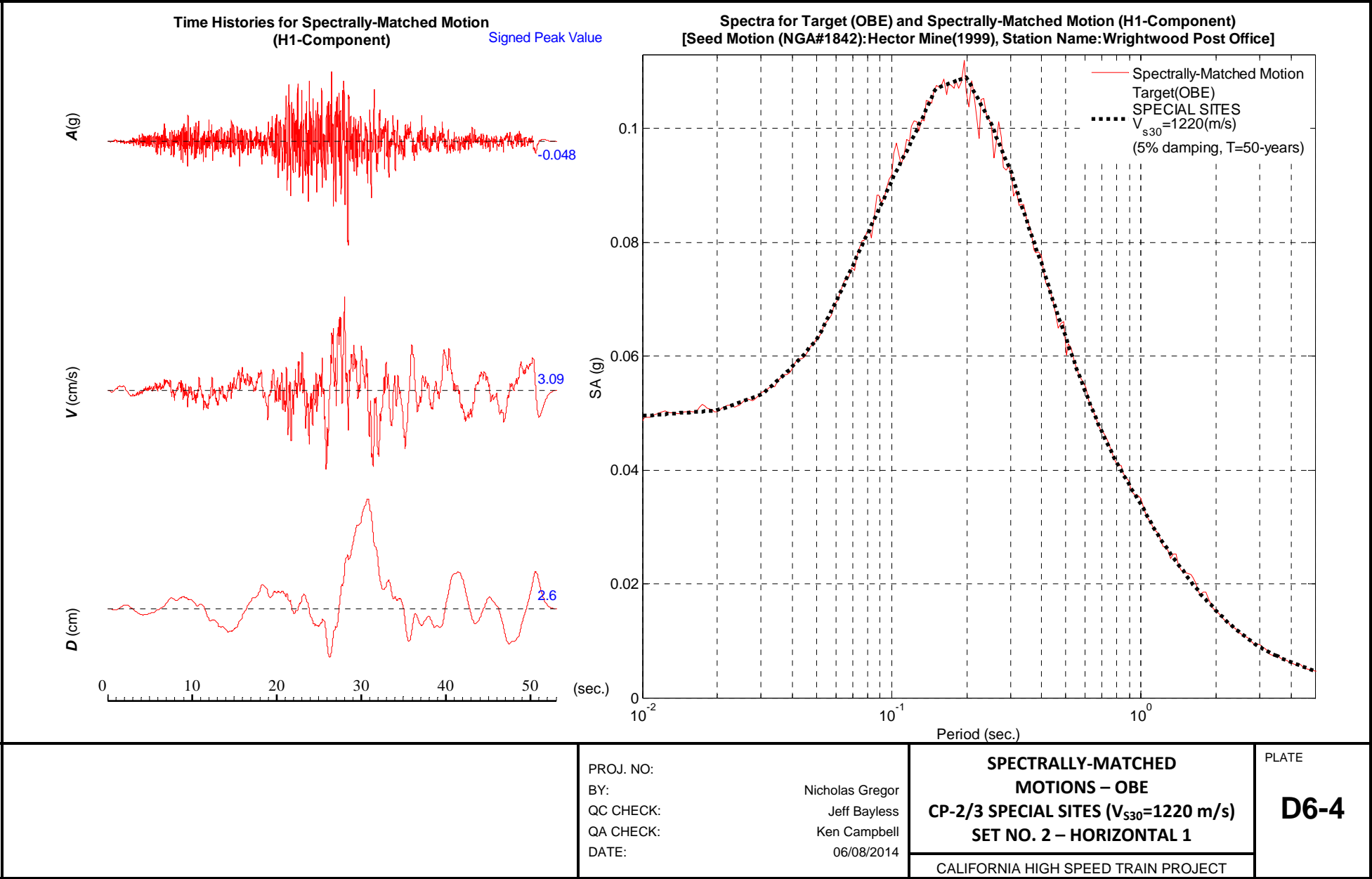


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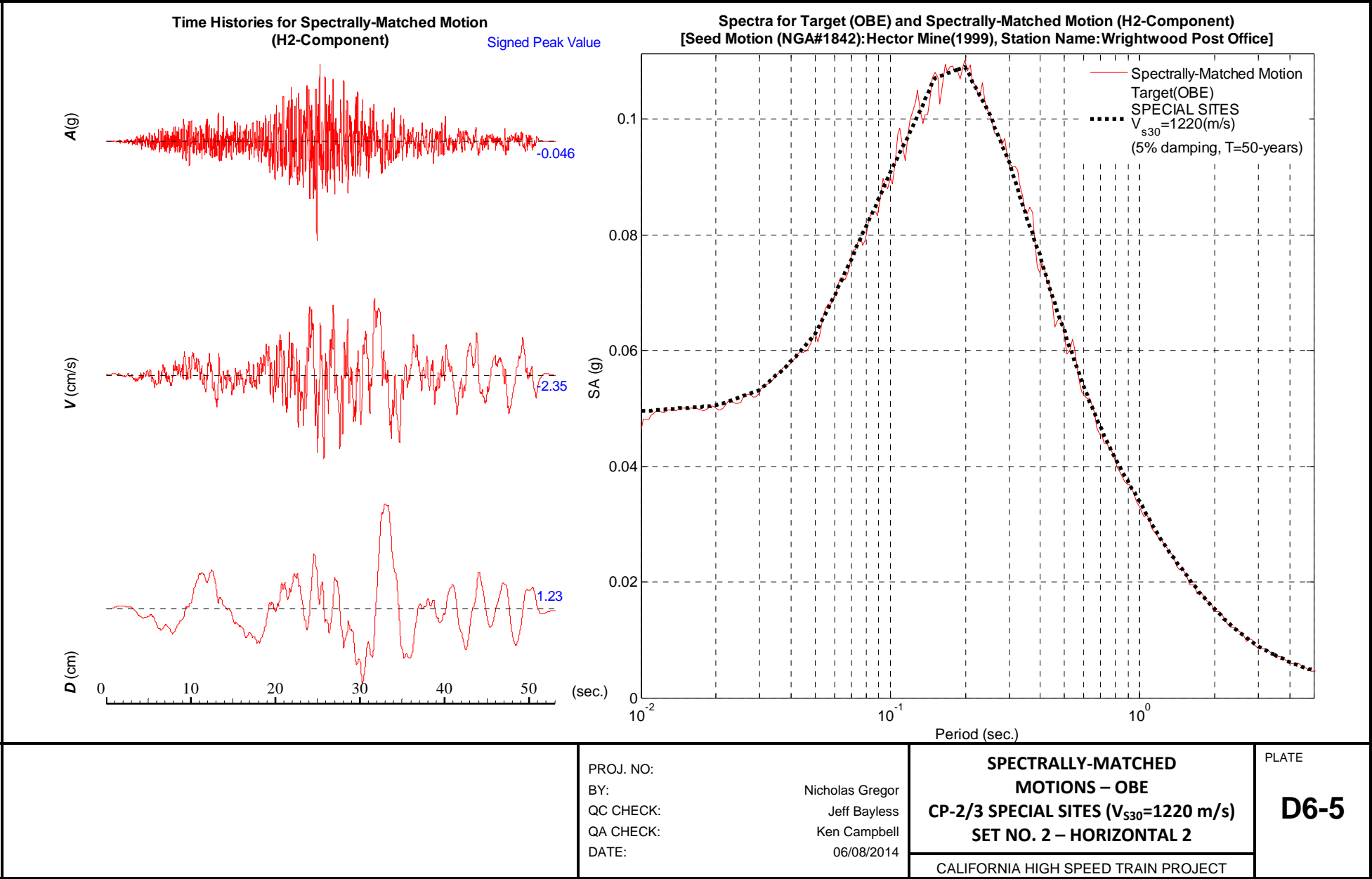


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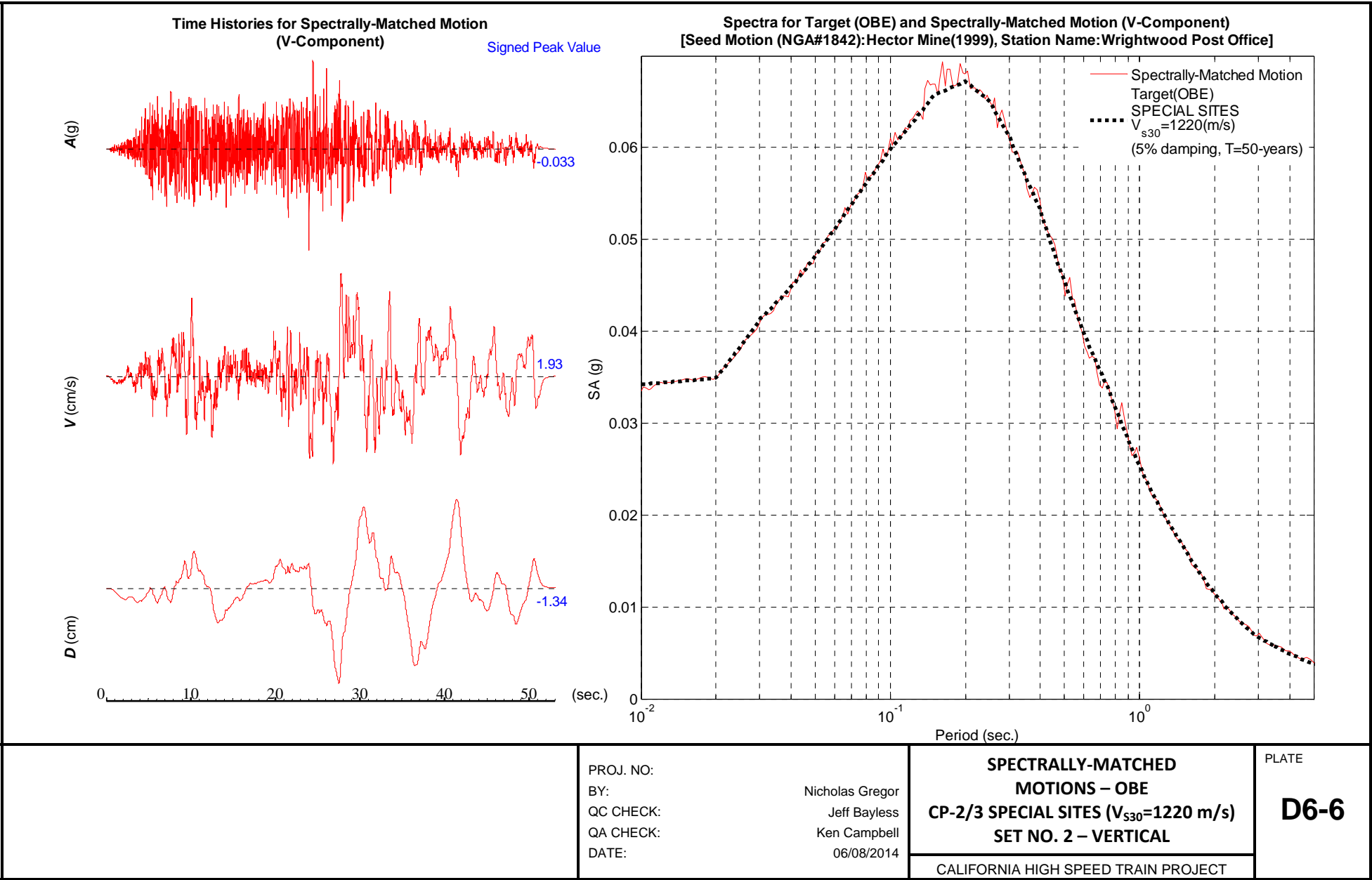




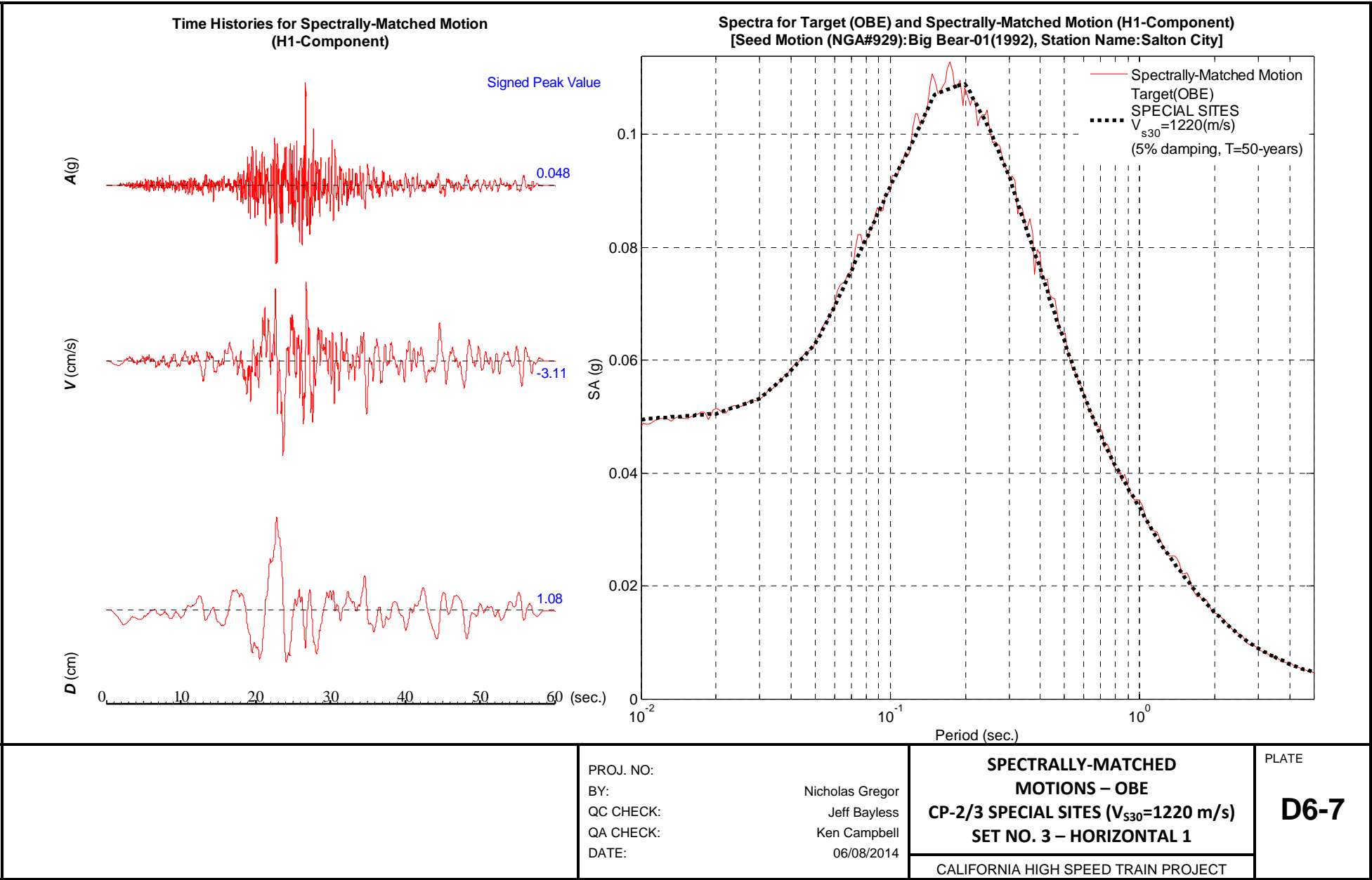
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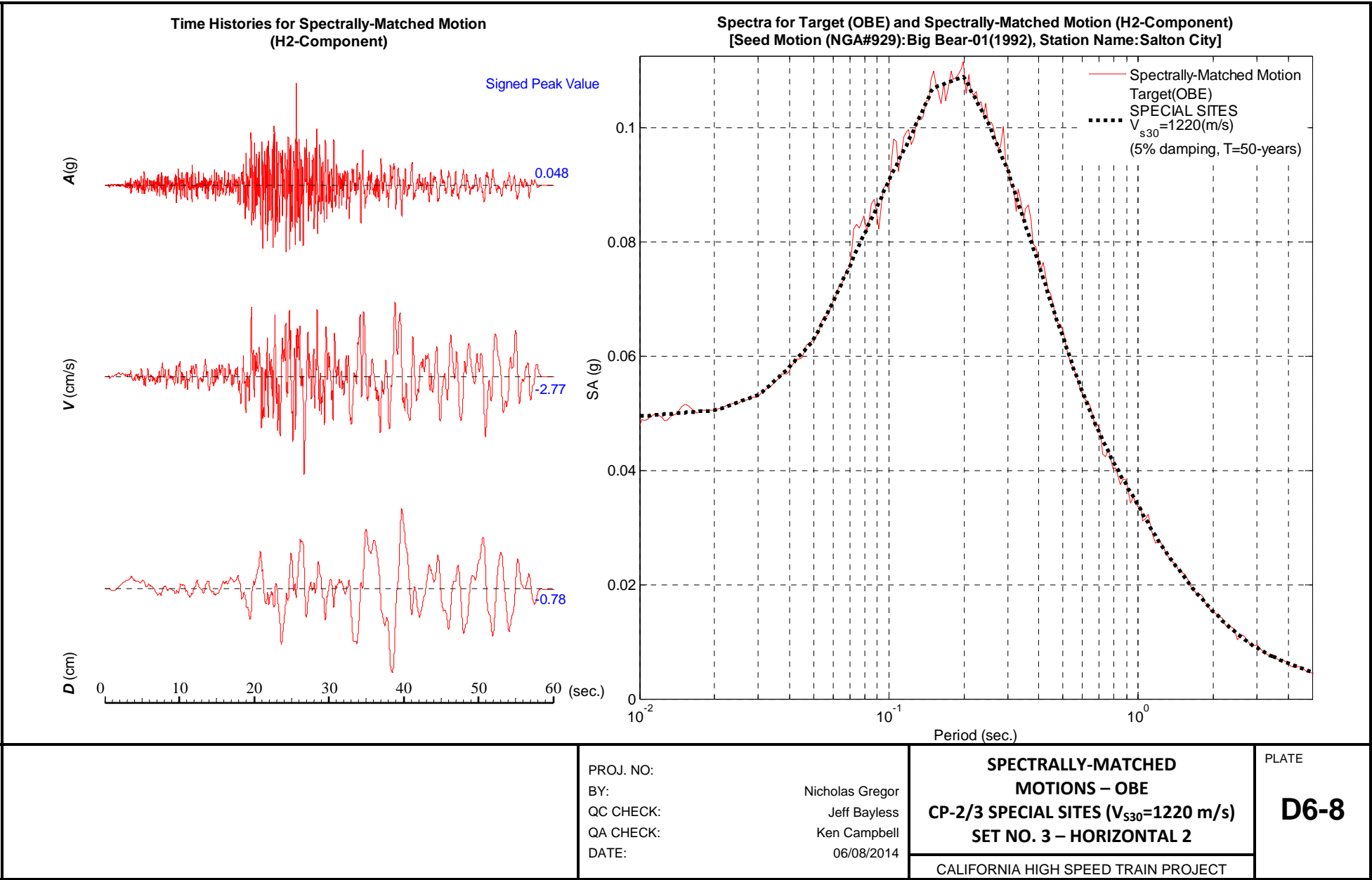
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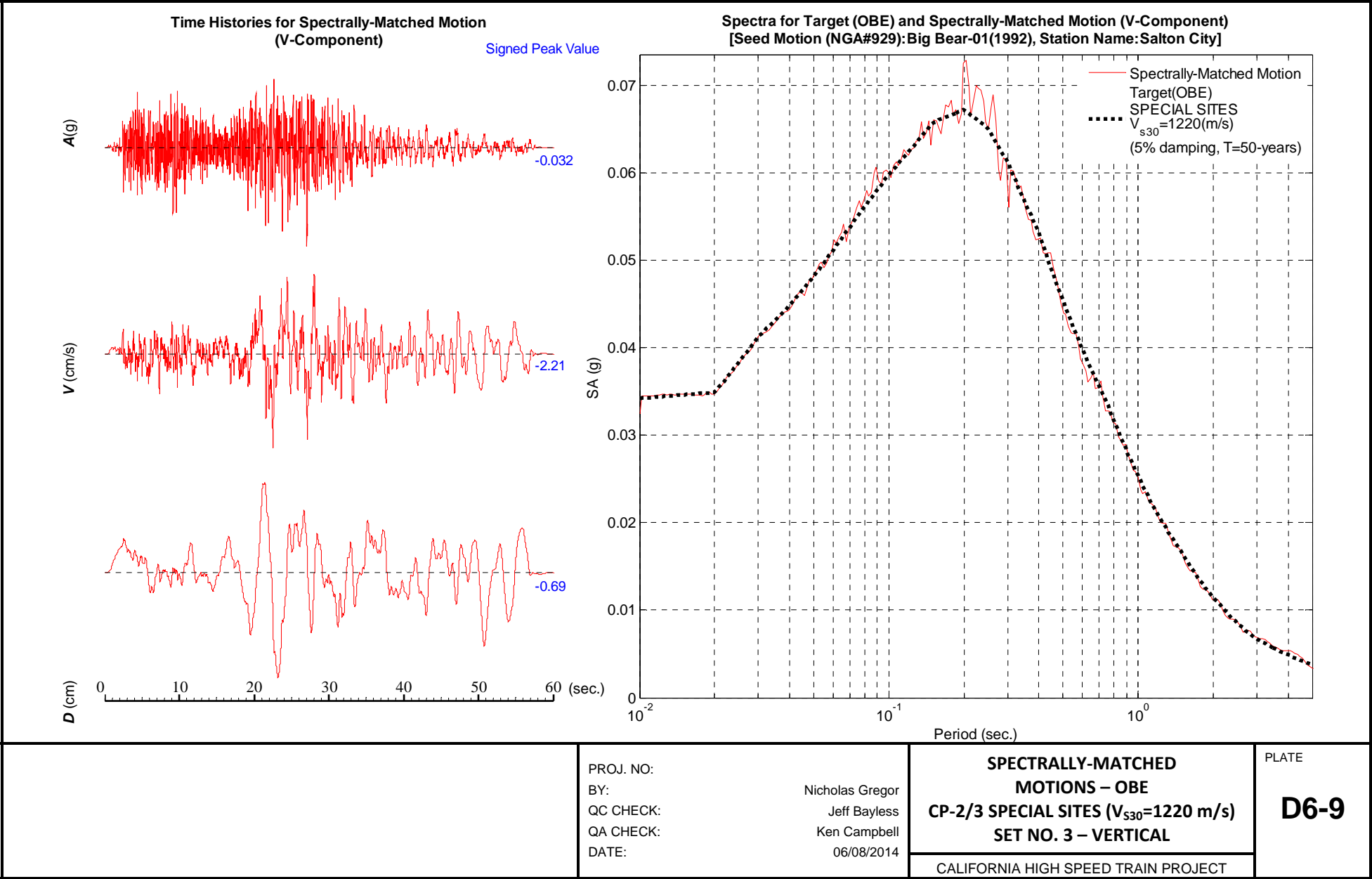


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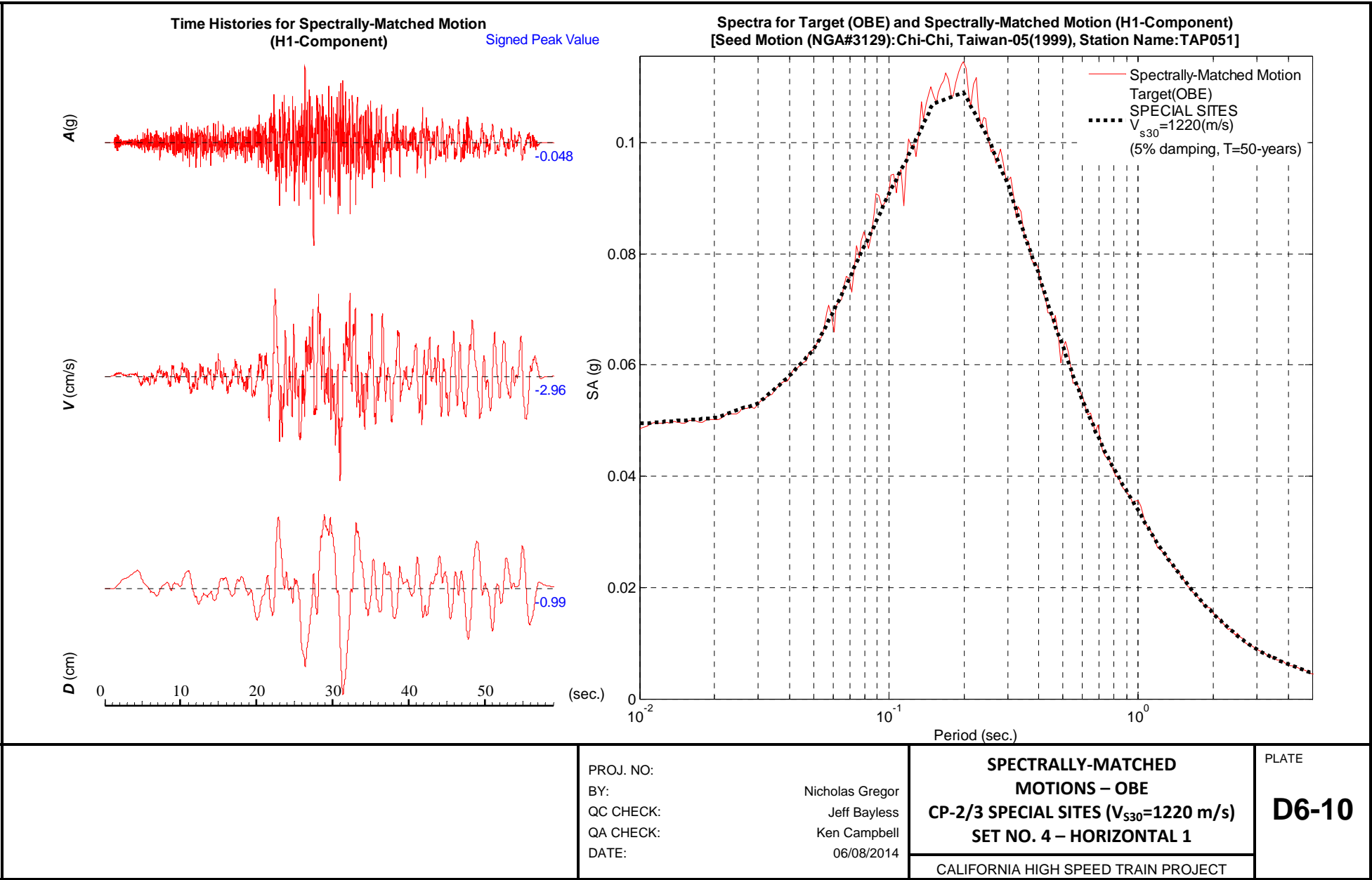




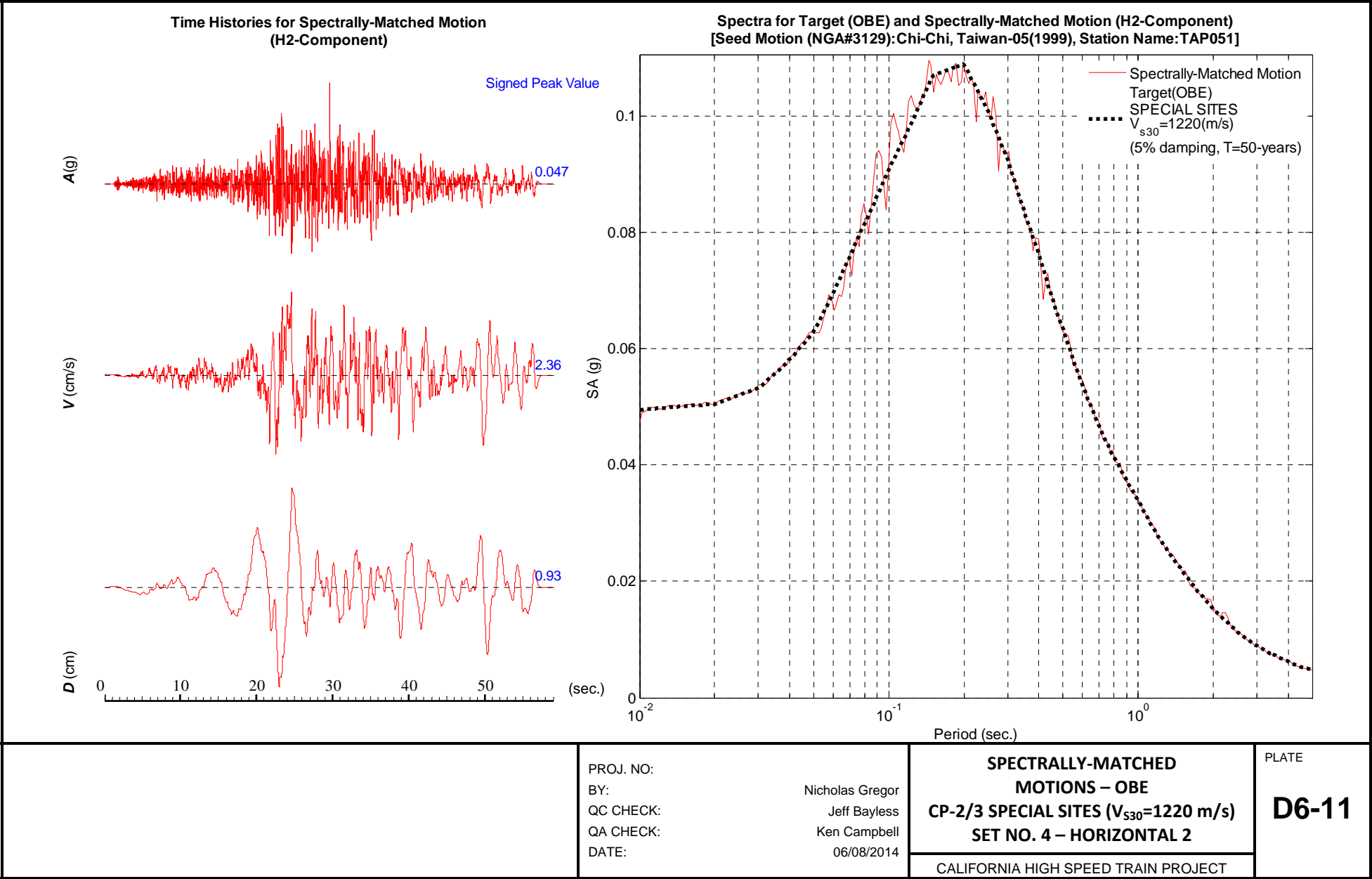


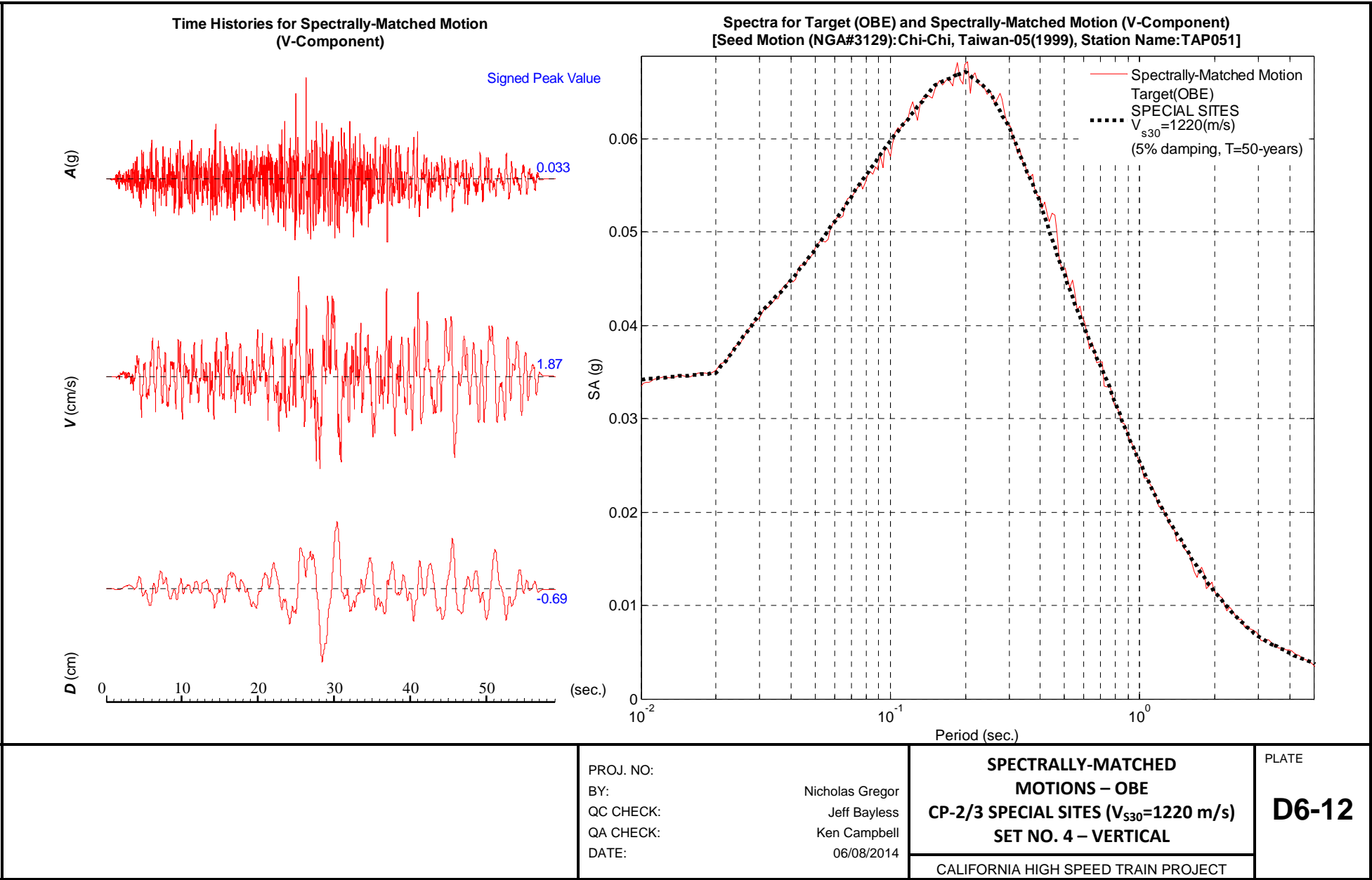


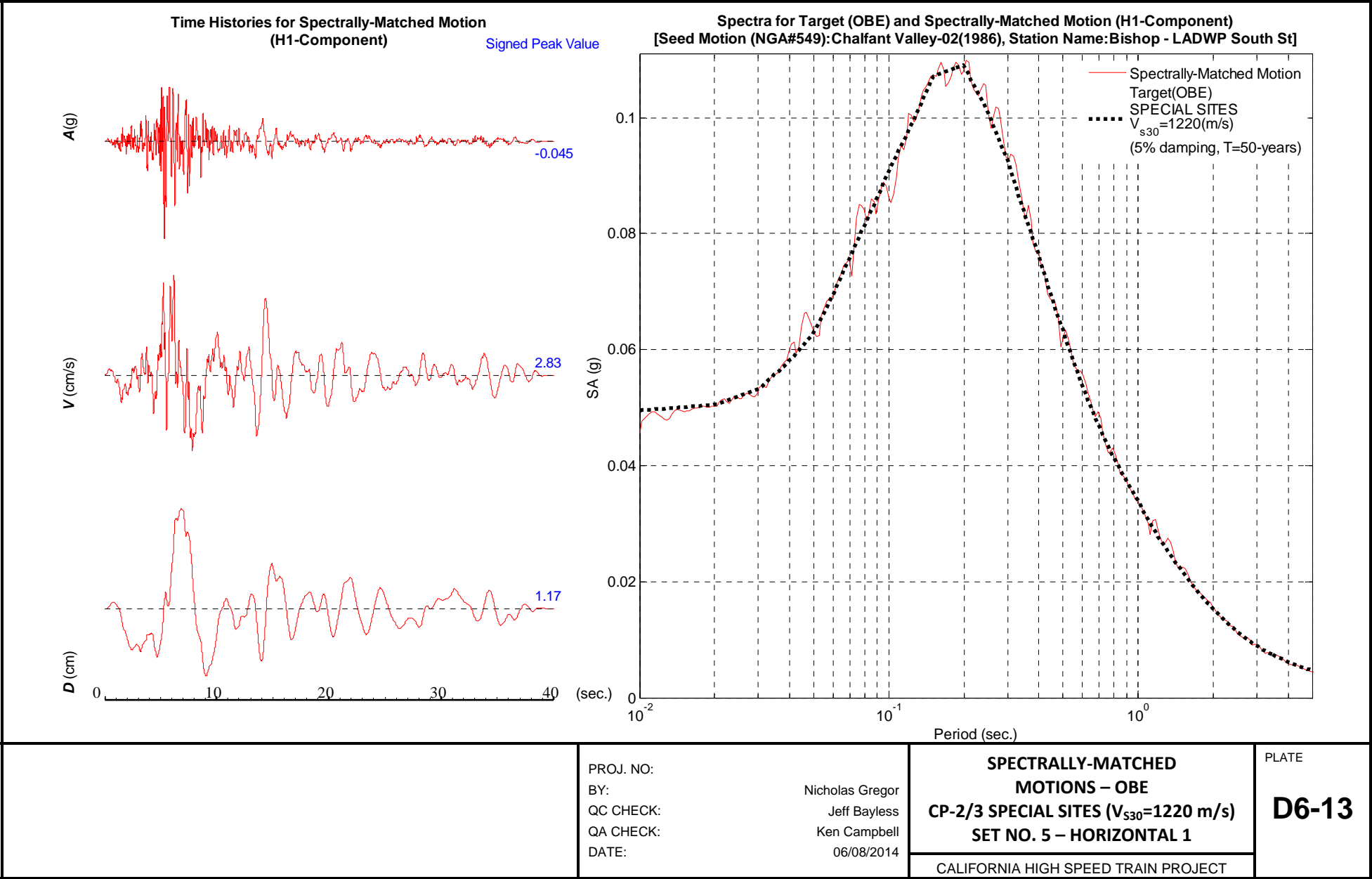
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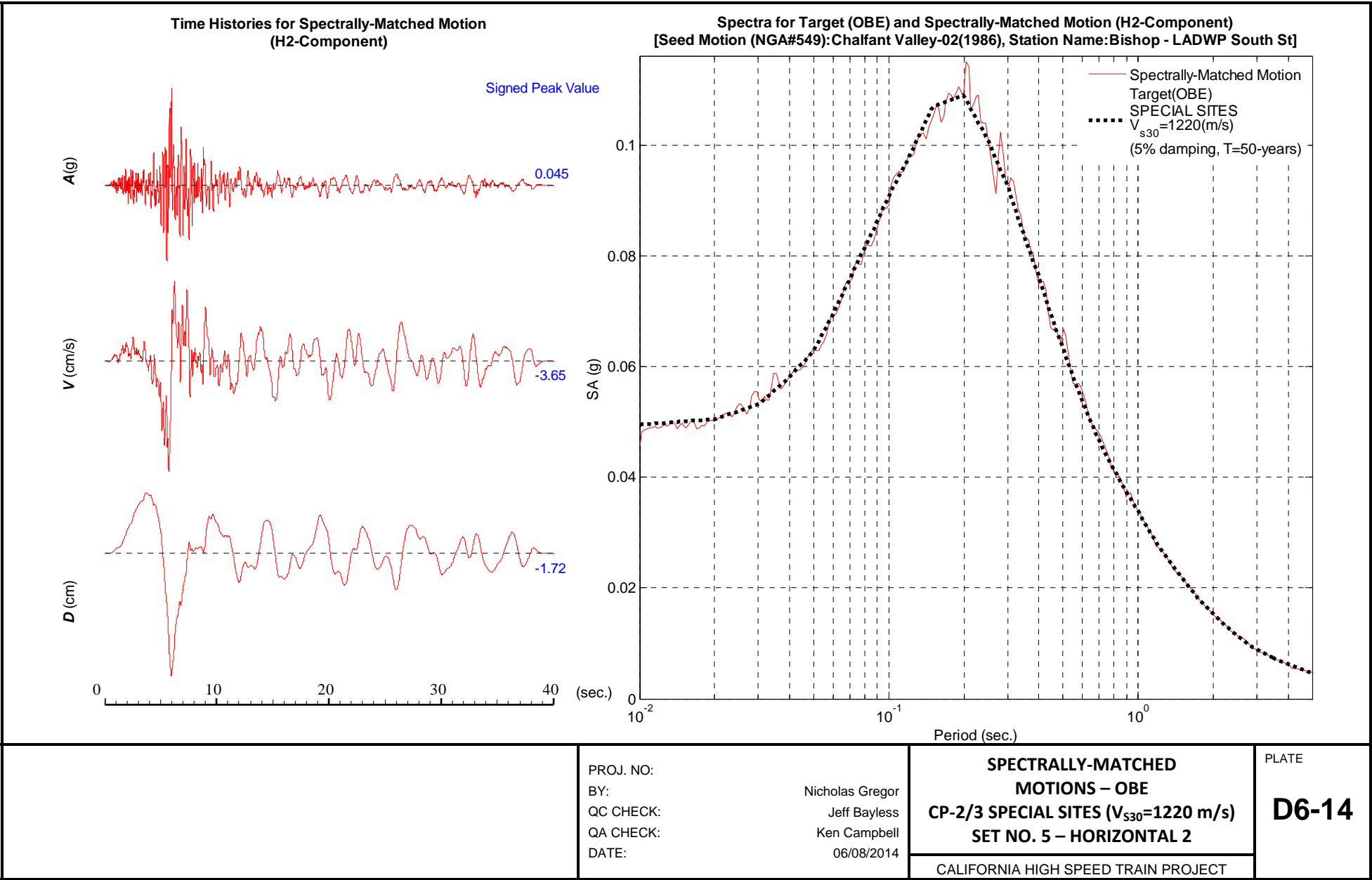
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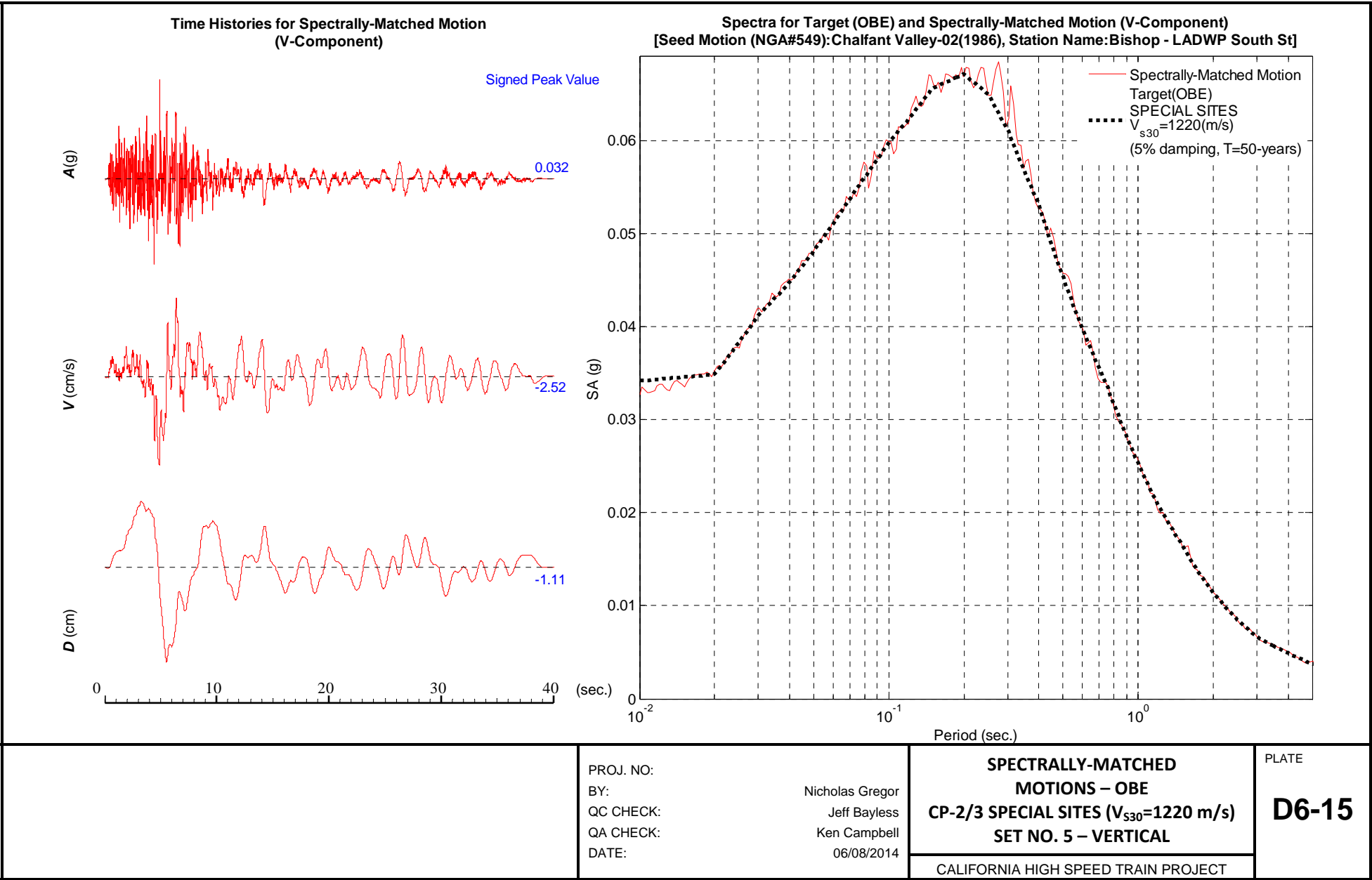






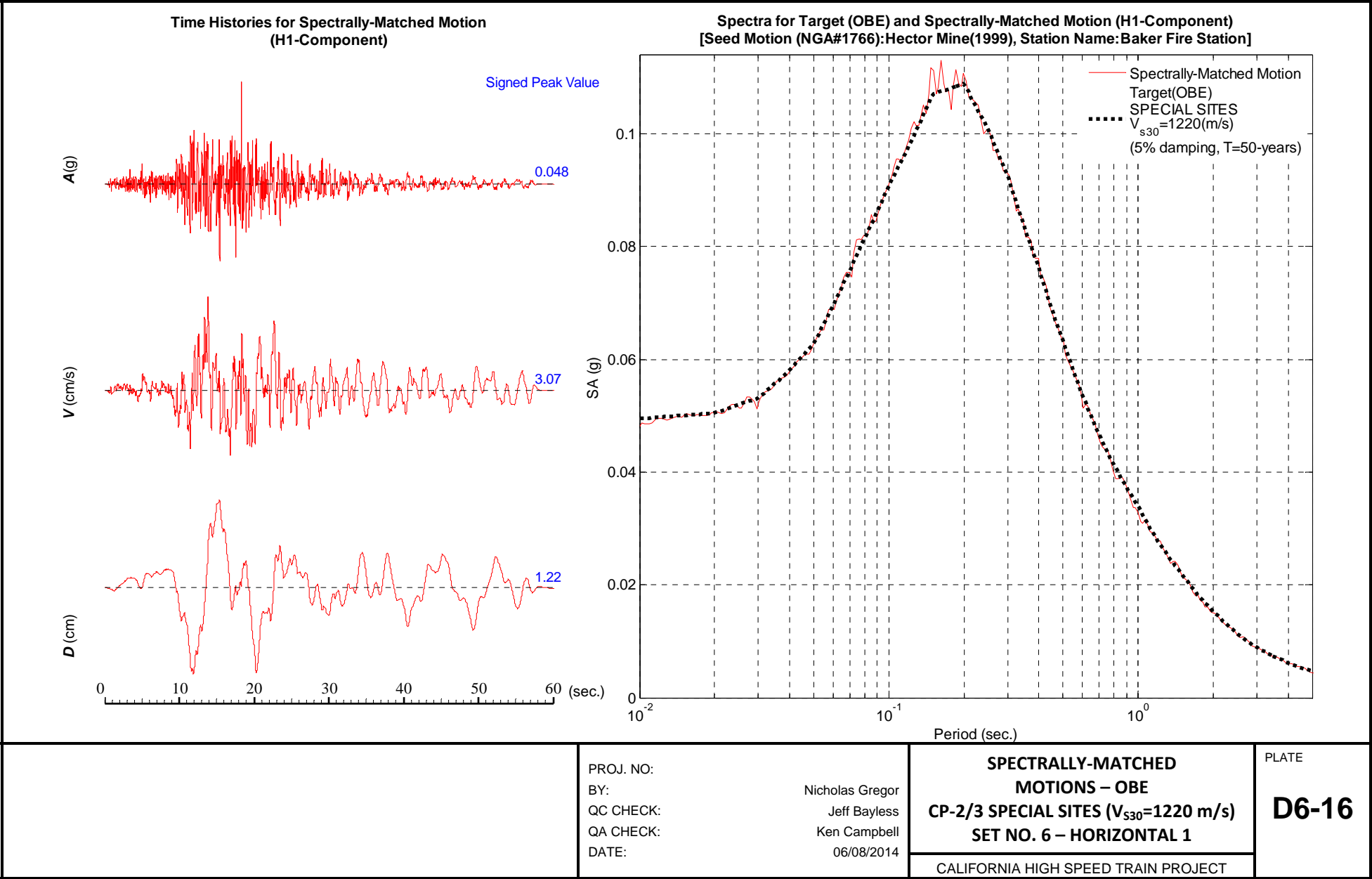
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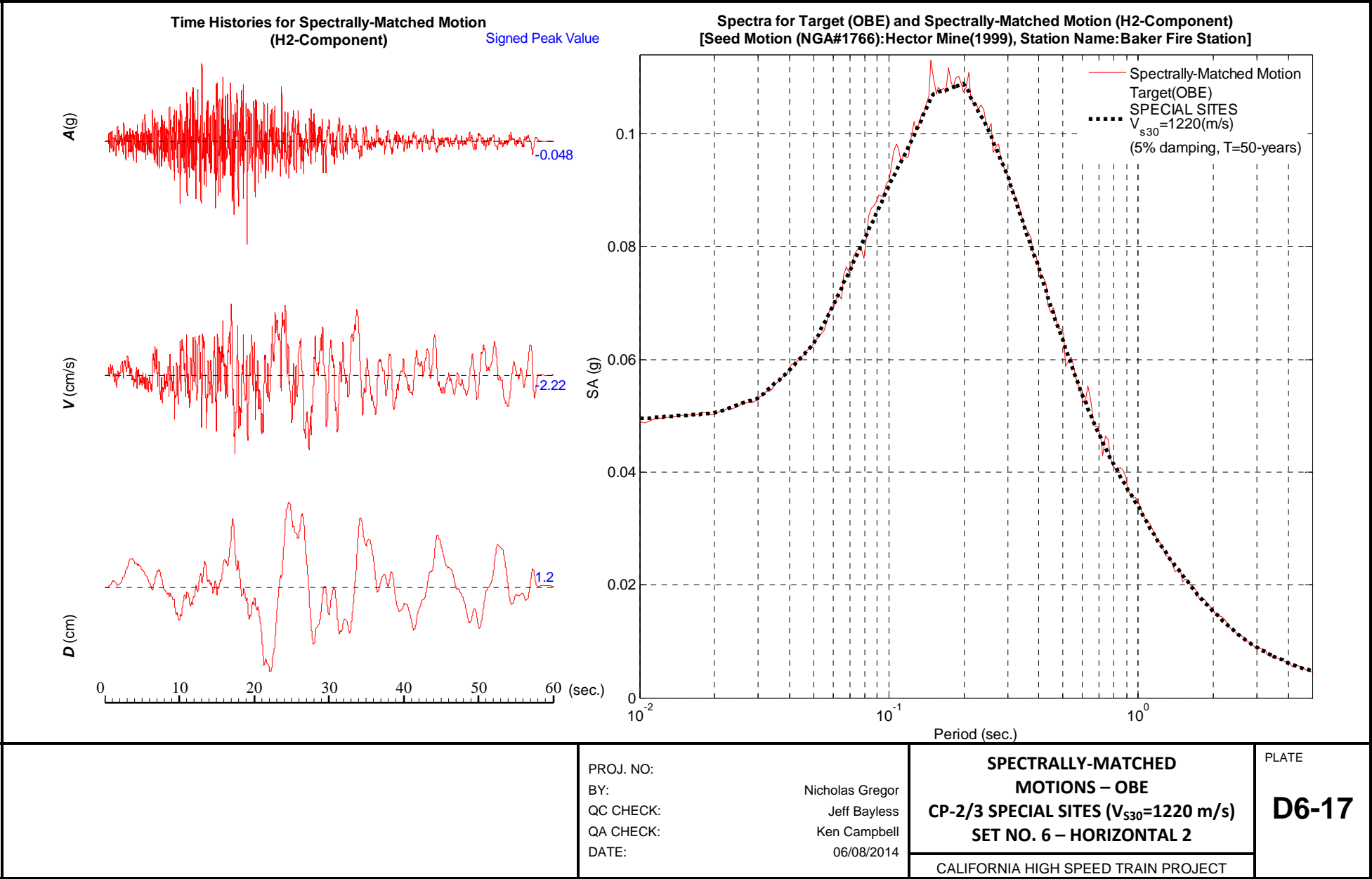




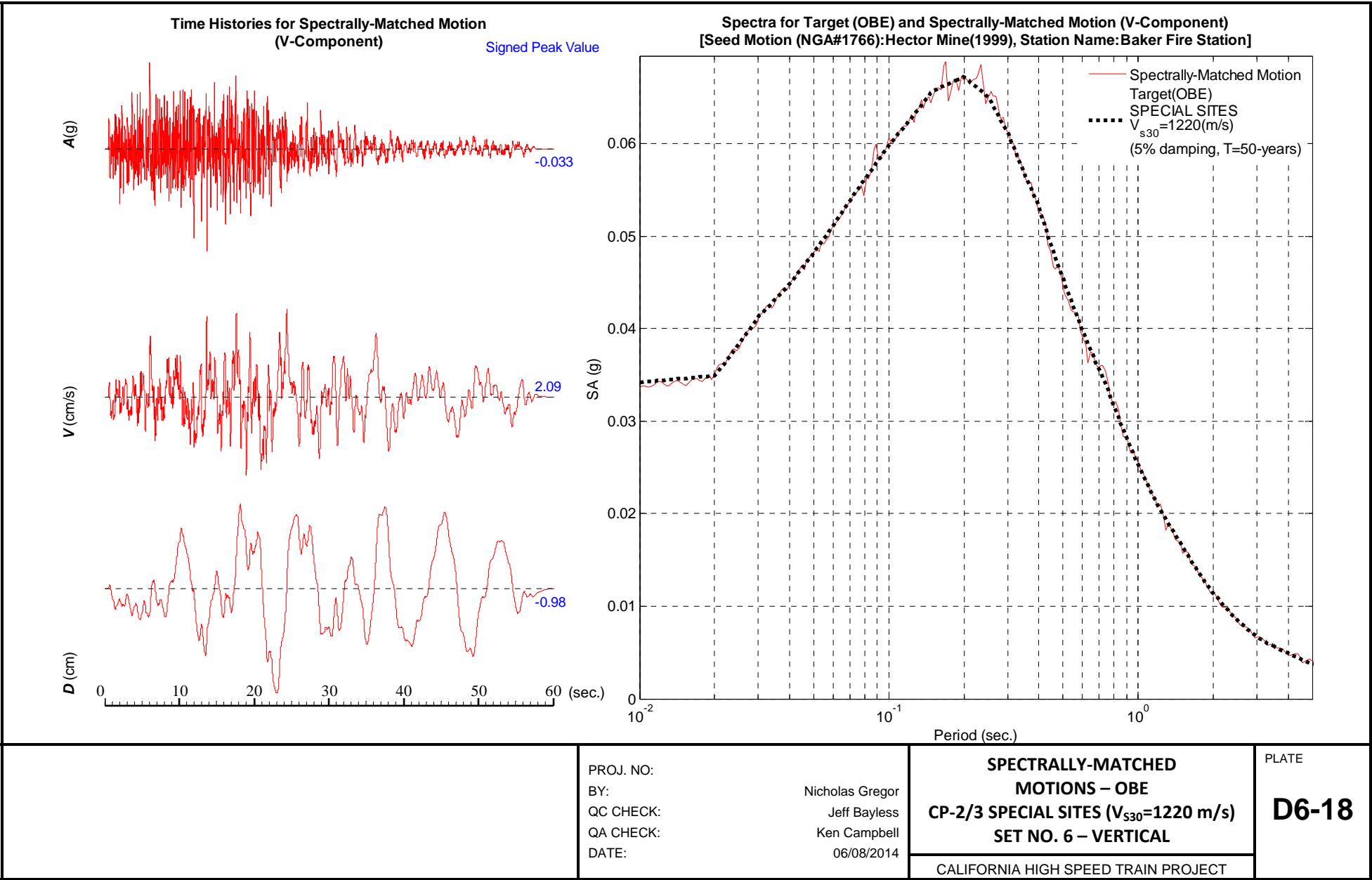
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